THE

ELECTRICAL REVIEW.

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THE

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PARLIAMENTARY ELECTRICAL ENERGY COMMITTEE.

IT seems to have been the general opinion of counsel and of all others engaged in the Parliamentary Committee, whose proceedings we have reported at considerable length, that the matter was carried through at a great rate, and that the issues were much confused. It is pretty clear that there has not been time to sift the whole matter, and that whatever the report of the Committee, it will scarcely be final. If the Committee are prompt in their report, and there is time to draft a Bill embodying their recommendations and get it through the House this session, enough may be done to relieve the almost absolute block which there is at present; but it is perfectly evident that there are a number of other questions which are rapidly ripening for solution, and it is greatly to be desired that the electrical industry, as a whole, should begin to consider this carefully and organise themselves with a view to getting their case more strongly and authoritatively placed before Parliament than has been possible on the present occasion, mainly because of the short notice and rapidity with which the matter has been carried through. We think it is very desirable to urge the importance of the recommendations of the Committee being given effect to by Parliament this session, as another year's block, whatever is done in the end, would leave us another 12 months behind our foreign rivals.

We are hopeful from what was gathered of the general tone of the members of the Committee and the evidence, that, at any rate, some of the discouragement to which private enterprises are subjected at present may be removed. We doubt if very much will be done directly to this end in the Committee's report, in fact, we do not know whether from the nature of the reference to them they can do much, but the evidence was strong in favour of the old political economic dictum that officials favour officials, and that although the Board of Trade were supposed to have a discretion to give private enterprises at any rate a fair chance, yet that in practice their powers had so been used as to put a complete stopper on it. Sir Courtenay Boyle practically acknowledged this himself, and we think most people will agree that it is so, and to a greater extent than appears on the surface, since a certain number of companies did get through in the earlier stages, and when private individuals felt less hopeless than they do now of carrying out any enterprise. We believe it will be found to be a fact that notwithstanding the enormous increase of electrical enterprises in other countries, the *rate of increase* in this country is not progressing. In fact, we are not sure if apart from the manufactures carried out to supply Corporations and what may be called purely private work it is not diminishing, although both in Germany and America it is progressing by leaps and bounds.

In connection with this we might refer to the reports from Berlin in the *Financial News*, and the large space which is

given very frequently to particulars of electrical enterprises, whereas in the same paper the reports on English enterprises are at most three or four lines, and these deal almost entirely with London companies.

Again, we would point out the unfairness of the matter to those engaged in the electrical industry. Of course, now private enterprise is pretty well snuffed out for ordinary undertakings; but, at the same time, it is true that the teaching of the local authorities, the bringing forward of facts and new ideas, and their education, has almost entirely been done by private individuals, often at great expense both of money and time. Although such men deserve well of the nation, and it is on the labours of such men in other departments that the greatness of England has been built; in the case of the electrical industry, owing to the state of the law, and the action of municipalities, they have not only received no reward or encouragement, but have been pushed aside often with contempt, and left to bear heavy loss and discouragement.

If our rivals in America and Germany were pursuing the same course as ourselves the matter would not be so serious, because we and our trade rivals would be in the same boat, and one would have no advantage over another; but that is not so, and we think it is acknowledged on all hands that both our great commercial rivals have got a considerable start of us in this matter, and the encouragement there is for them to proceed with further developments will undoubtedly enable them to keep ahead of us, and probably to increase their lead, unless strong measures are taken to put the members of electrical industries in this country in at least as favourable a position for the development of enterprises as are our industrial rivals.

We hail with satisfaction the activity which has characterised local bodies for some years; at the same time we cannot help thinking that often, not being very well instructed, there is far too great a tendency amongst them to conclude that what is sauce for the goose is sauce for the gander in all cases, and that because such towns as Manchester, Edinburgh, and some other municipalities of large area, and where commercial intelligence of a high order can be secured on the Town Council, have done ostensibly well, that consequently it follows that comparatively small towns of a different character, and where the majority of the members cannot usually have the same business experience, can produce similar results.

The Candle-Power of Arc Lamps.

In a recent issue of the *Electrical Review* of New York, Mr. Marks, of enclosed arc lamp fame, replied to the question of a correspondent who asked, "What is the candle-power of an arc lamp using 45 volts and 10 amperes?" by detailing the reasons which make it impossible to answer this query with any degree of accuracy. Although it has been common knowledge for many years that any statement of the candle-power of an arc lamp was certain to be misleading if unaccompanied by full details of the conditions under which the test was made, yet it is probable that the extent of the possible error is not so generally known, and the figures given by Mr. Marks will therefore be of interest. It is said that there are five different candle-power values which are used at various times, viz.: (1) Nominal candle-power, the value of which, according to the definition adopted by the National Electric Light Association, is 2,000 for a 450-watt lamp. (2) Horizontal candle-power which has been given by different experimenters at figures varying from 227 to 456. (3) Maximum candle-power which has been given at figures varying from 1,080 to 2,000. (4) Mean spherical candle-power which has been given at figures varying from 425 to 653. (5) Mean hemi-spherical candle-power below the horizontal plane passing through the arc, which Mr. Marks gives as 600. But if it is decided that results shall be given in one particular value of the five named above, say, for example, in mean spherical candle-power, and if full information is given concerning the globes or reflectors used and whether the test is made in a dark room or at the place where the lamp is in service, there still remain variations due to quality and size of carbons, shape of the carbon points, and personal errors of observation. Mr. Marks says that it has been found that the substitution for one carbon of another of different quality has made as much as 80 per cent. difference in the mean spherical candle-power, and that with carbons of the same quality there may be a difference of 30 per cent. in the candle-power according to whether the carbon is $\frac{7}{16}$-inch or $\frac{8}{8}$-inch diameter. With regard to personal error, a test is quoted where with 10 observers a variation of about 13 per cent. was found between the highest and lowest results obtained; and we are finally reminded that there are three important standard candles which may be referred to, viz., English, German, and French, and that there is a difference of about 15 per cent. between the values of the first and last named. After reading the article in question, it is strongly borne in on us that the only safe answer to such a general question as that of our contemporary's correspondent is, that the candle-power can best be represented by x, as tests can be quoted to show that it has any value between about 200 and 2,000 according to the conditions of test; and that in comparing the efficiency of arc and incandescent lamps for lighting purposes, it is necessary to reckon on 1 to $1\frac{1}{2}$ watts per candle for an arc lamp instead of on the lower figures which are often used.

Rayleigh on Stokes.

Sir G. Stokes, about two years ago, suggested a theory of the Röntgen rays, according to which the Röntgen rays were regarded as aperiodic electro-magnetic waves caused by the impact against the anti-cathode of the charged particles in the cathode stream. This theory has recently been developed by J. J. Thomson (*Phil. Mag.*, Vol. 45, p. 172, 1898), and has come much into favour with other authorities. In *Nature*, April 28th, however, Lord Rayleigh raises a protest against the acceptance of this theory. He says it has certainly much to recommend it, but he cannot see that it carries with it some of the consequences which have been deduced as to the distinction between Röntgen rays and ordinary luminous and non-luminous radiation. The conclusions of its supporters "that the Röntgen rays are not waves of very short length, but impulses," surprise Lord Rayleigh. From the fact of their being highly condensed impulses, he would conclude, on the contrary, that they *are* waves of short wave length. He asks what becomes of Fourier's theorem and its assertion that *any* disturbance may be analysed into regular waves? The view that the vibrations of ordinary light are regular, and thus distinguished from disturbances made up of impulses, he says, is an exploded idea, in the theory of light. A curve representative of white light, if it were drawn on paper, would show no sequence of similar waves. Rayleigh favours the view that Röntgen rays differ from ordinary light only in the shortness of their waves.

THE ST. PANCRAS DESTRUCTOR WORKS.

We illustrate below a side view of the Hornsby water-tube boiler which has been fitted up at the St. Pancras Vestry destructor works, and is fired by the waste gases from the destructor.

The rating of the boiler, if fired by coal, is 118 H.P. (1 H.P. = 30 lbs. of water evaporated per hour) working pressure 120 lbs. per square inch, number of tubes 59 (seven deep, three rows of nine wide and four rows of eight wide), 18 feet long and 4 inches diameter. The steam drum is 39 inches diameter × 23 feet 10 inches long, and is provided with a patent separator to ensure dry steam; it is fixed over the uptake tube from the front header. The headers are provided with a hand-hole opposite each tube, and each hand-hole is provided with a mild steel internal safety cover. The mountings consist of one deadweight safety valve, high steam and low water, with whistle alarm; one 2-inch deadweight safety valve; one steam stop valve; one steam gauge dial 10 inches diameter; one check feed valve 1½ inch diameter; one blow-off valve 2 inches diameter. The boiler is made throughout of mild steel, no cast-iron or cast-steel being used in its construction.

We are informed that the boiler has done excellent work and given every satisfaction.

The St. Pancras Boiler.

THE TEMPERATURE OF INCANDESCENCE LAMPS.*

I have already described† a purely electrical method of measuring the temperature of incandescence lamps, and more generally, of any radiating body whatever. This method consists in studying: (1) the variation in the resistance of the lamp as a function of the difference of potential at the terminals; (2) the variation, as a function of the time, in the resistance of a lamp which is cooling. From this we can easily deduce the curve of the watts radiated as a function of the time, and consequently, the total number of joules or small calories given off by the lamp. The filament is then weighed, and from M. Violle's formula:—

$$Q = \cdot 355\, t + \cdot 00006\, t^2$$

we deduce the temperature t (assuming that the filament is made of pure carbon).

This method was applied, under my directions, by Messrs. Gindre and Fréauff-Ozeune, then pupils at the Ecole Supériure d'Electricité‡; the first measurements were taken with the aid of an amperemeter and a voltmeter and presented no difficulty; the subsequent ones were more difficult; they were carried out in the following manner:—

A special interrupter enables the following operations to be performed:—

1. At the time zero, the current of the lamp is broken.
2. Immediately after, the lamp is introduced into an auxiliary circuit including an accumulator and a resistance box.
3. At the time t, an instantaneous contact brings the two terminals of the lamp into connection with the plates of a condenser.
4. This condenser is discharged through a ballistic galvanometer. These various operations are executed by a slide which moves in a direction parallel to itself between two grooves; the intervals of time are measured by a tuning fork which inscribes its vibrations on smoked paper; it is evident that at these high temperatures the cooling is very rapid, and that it is necessary to be able to measure accurately fractions of a second. A simple calculation then enables us to find the resistance of the lamp at any given moment.

The experiments were carried out on four lamps, A, B, C, D, of 65 volts and 10 candles. I will call t the temperature, R_o the resistance of the lamp to the ordinary temperature, R_t its resistance to $t°$, p the weight of the filament expressed in milligrammes, E the tension at the terminals. These are the results obtained:—

Lamps.	E	p	R_o	$\frac{R_t}{R_o}$	t
A	65	6·3	175	·53	1,720°
B	65	5·35	170	·54	1,610°
C	65	5·2	170	·52	1,630°
D	65	4·8	170	·53	1,620°

We see that the results relating to the lamps B, C, D are very similar; the lamp A, for some reason or other, gives a somewhat higher temperature.

However this may be, the above results are of some importance when we consider the differences in the figures of the various writers that have treated this subject. H. F.

*Note presented to the Académie des Sciences, March 7th, 1898.
†See *L'Electricien*, Vol. xii., p. 323.
‡The experiments were made at the Central Electrical Laboratory.

Weber, in fact, mentions these temperatures as hardly exceeding 1,300°, whereas M. le Chatelier gives 1,800°.* It will be seen that our results more nearly approximate to the latter estimate, especially as we have reason to think that our lamps were less *over-run* than those of M. le Chatelier; these are the variations of resistance given by him:

t	...	...	...	$\frac{R_t}{R_0}$
15°	...	...	...	1·00
700°	...	...	...	·75
1,000°	...	...	...	·66
1,400°	...	...	...	·57
1,800°	...	...	...	·49
2,100°	...	...	...	·44

At the temperature of normal working, the ratio $\frac{R_t}{R_0}$ was ·49 for M. le Chatelier's lamps, whereas this same ratio attained to ·53 in our experiments; now, at this value ·53 corresponds exactly to the temperature 1,600° in M. le Chatelier's table.

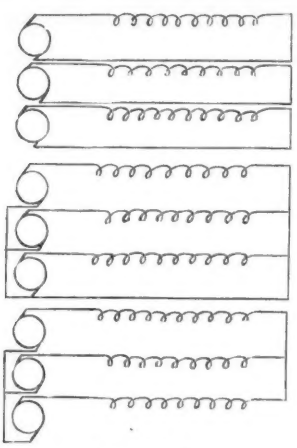
The principal cause of error in the above experiments lies in the light weight of the filament; it would be easy to remedy this by working with low voltage lamps. We can, in fact, easily show that, with an equal lighting power the weight of the filament of a lamp varies in inverse proportion to the two-third power of the difference of potential at the terminals.

From the above experiments we can deduce curves of the variation of the total radiation as a function of the temperature, but this question is too important to be entered upon here.

THREE-PHASE MACHINERY.

The *Western Electrician* for April 9th, 1898, contains an interesting article on three-phase machinery by W. M. Venable, in which some of the principles underlying three-phase working are expressly stated in a very simple manner for the benefit of those who are not able to make a thorough study of the subject and yet who require a good general knowledge of it.

If three alternating-current generators, supplying three separate circuits as in fig. 1, are connected together at one terminal only, the operation of the machine will not be affected. Such a connection merely brings the three terminals to a common potential, and does not affect the difference of potential between the two terminals of any one



Figs. 1, 2, 3.

machine. There will, therefore, be but little effect on the operation of the machines if a common wire is run for all, as in fig. 2.

If now we can arrange the circuits and construct the dynamos so that there will never be any current in the common return wire, we can dispense with that wire altogether. This condition is satisfied when the currents in the three remaining wires are 120° apart in phase and equal in intensity.

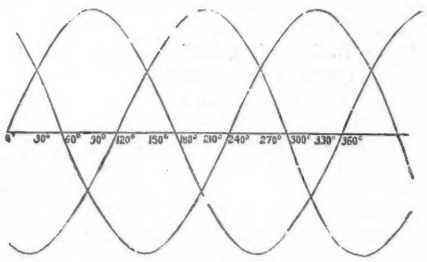


Fig. 4.—Sine Curves of Three-Phase Circuit.

Fig. 4 represents three equal sine curves 120° apart, and shows that the algebraic sum of the ordinates at any instant is zero. We have, then, the arrangement shown in fig. 3, and if the loads in the three branches are equal, three line wires only are needed. The easiest way to keep the machines 120° apart in phase is to combine the three machines in one, that is, to put three windings on one armature. Such machines are called three-phase alternators. A simple one can be made of a Thomson-Houston arc dynamo by bringing the terminal wires to collector rings instead of to the three commutator segments. The fields have to be separately excited.

Fig. 5 is a diagram of such a winding.

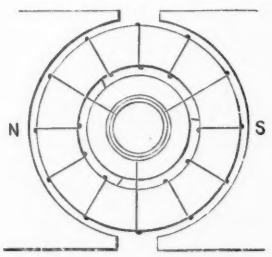
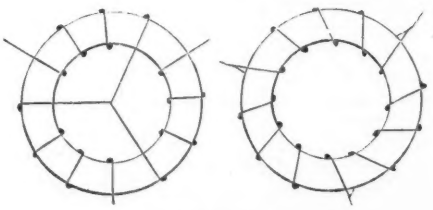


Fig. 5.—Three-Phase Winding for Two-Pole Machine.

The number of poles can, of course, be increased, just as in an ordinary alternator, increasing the frequency of alternations.

There are two ways of connecting the armature coils of a three-phase alternator. One of these, known as the star connection, is shown in fig. 6; the other, known as the mesh winding, is represented in fig. 7.



Figs. 6 and 7.

One of the great advantages of three-phase working over single-phase systems lies in the fact that the energy transmitted can readily be used either for lighting purposes or for motive power. Three-phase induction motors are, as is well known, self-starting under a very considerable load, and are as simple, reliable, and as easily controlled as the continuous current motor. The induction motor is superior to the continuous current motor, in that its secondary winding is short circuited, and it is entirely devoid of commutator, collector rings, or any rubbing contact.

* *Journal de Physique*, 2nd series, Vol. i., p. 203.

Those readers who have not the time to study the subject deeply, will be able to form some idea from the above of the nature of the generation and distribution of electrical energy by means of tri-phase currents. There is novelty and great simplicity in the method of showing how it is necessary to use only three wires in three-phase distribution systems.

THE RANGE-FINDER FOR DETERMINING THE DISTANCE OF A HOSTILE SHIP OR FORT.*

The accuracy of modern rifled guns is one of the wonders of engineering. Two experimental shots fired a few years ago at the same elevation from the same gun fell within 30 yards of each other, after traversing a distance of 12 miles. If a modern rifle is laid upon the target, with proper elevation and allowance for windage, it is safe to say the shot will find the mark.

The correct elevation of the gun can only be determined if the distance of the target is known, and the exact determination of the distance of a moving object is a problem that has worried the gunner ever since the day when round shot was first thrown from the sides of the wooden fighting ship.

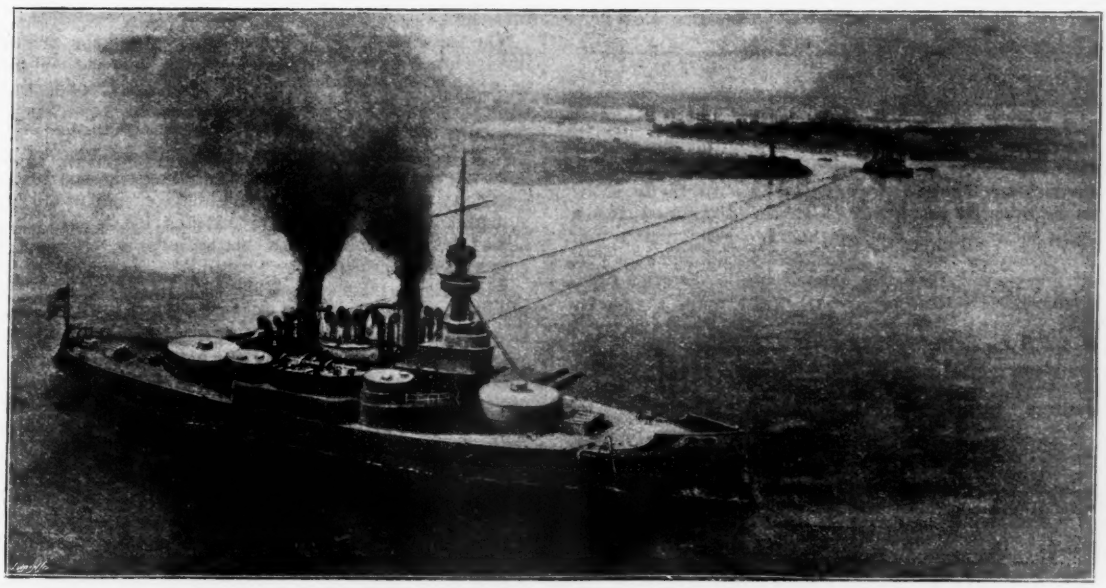
In the early days, the determination of the range was a matter of guesswork. The gunner assumed a distance, elevated his gun accordingly and watched the course of the shot. If it fell short, he increased the elevation, and if it passed over, he decreased it.

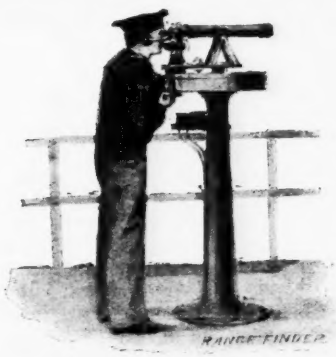
This was all very well in a day when the guns were too feeble to do much execution, except at close range, and a few dozen shots thrown away made little impression upon a ship's magazines. With the advent of modern ordnance, however, with its 60-ton guns and costly charges, the necessity of accurate fire became imperative, and ordnance experts set about devising some scientific method of finding the range at sea. The earliest and best known device of the kind was the invention of Lieut. Fiske, of the United States Navy, which has been installed on many of our ships and is widely in use in the various navies of the world.

The Fiske range-finder is based upon the well-known principles of land surveying with the transit and engineer's chain. If a surveying party came to a broad river whose width has to be determined, a base line is measured along the bank, and the angles which this line makes with a mark on the opposite bank are measured by the transit. Then, knowing the length of the base line and the two angles, the distance across the river can be determined by trigonometry.

Applying this to the range-finder, a base line is carefully measured between two points near opposite ends of the ship, and over each point a range-finder, answering to the engineer's transit, is permanently set up. If the telescopes of the two finders are simultaneously converged upon the same point on a distant object (ship, fortress, or city), the observers will be in possession of the trigonometrical data necessary to compute the distance, namely, the base and the two base angles.

In the din, hurry, and slaughter of a sea fight, however, it would be difficult to make the necessary calculations, as the distance between the ships, and, therefore, the observed angles, keeps changing, and in order to make the determination of the distance automatic, Lieut. Fiske placed his telescopes in the circuit of a Wheatstone bridge and caused their change of position to record the distance of the object on the graduated scale of a delicate galvanometer. All that was now necessary was for the observers at the two range-finders to keep the cross-hairs of the telescope upon the same point of the ship, and the electric current translated (as it were) the angles into distances and recorded them by the movement of a needle over an arc graduated into hundreds and thousands of yards.



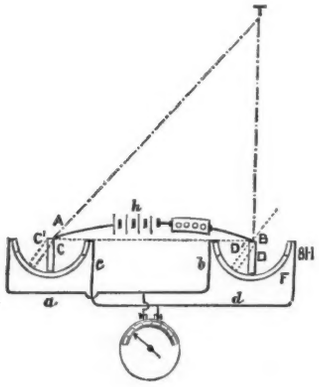


The above illustration will make the operation of this most ingenious instrument clear to the reader. It represents the *Indiana* about to open fire upon a hostile

* *Scientific American.*

ship. The converging lines are drawn from two range-finders, which are placed in elevated positions above either end of the superstructure deck. These finders are permanent fixtures, and the distance between them is accurately known. The smaller cuts show a range-finder and a diagram of the telescopes and the electrical connections.

The range-finder consists of a powerful telescope, which is



mounted on a standard and is capable of horizontal rotation above a graduated disc. Upon the disc, and extending an equal distance on each side of the zero point on the graduation, is a metallic contact arc. Fixed to the telescope standards is a contact strip, which rotates with the telescope and slides over the contact arcs. In the diagram A and B represent the centres of the discs on two range-finders, and C and D the arms that carry the telescopes and contact strips, which are shown sliding in contact with their arcs. The electric current from the battery, *h*, passes through the centres or pivots, A and B, and then into the arcs. From the right-hand arc it circulates in the wires, *b* and *d*, from the left-hand arc in the wires, *a* and *c*, and traverses the galvanometer.

When the two telescopes are parallel, the equilibrium of the Wheatstone bridge is complete, and consequently the needle of the galvanometer shows no deflection. This equilibrium occurs, moreover, whatever be the position of the telescopes on the dial, provided that they are perfectly parallel. But if the telescope, C, for example, be turned until it is in the position, C′, the parallelism being destroyed, and, along with it, the equilibrium of the two parts of the bridge, the needle of the galvanometer will be deflected. This deflection will increase in proportion to the length of the arc traversed by the telescope.

But since the arc, C C′, is proportional to the angle at A, which is equal to the angle at T, it follows that the deflection of the galvanometer will be proportional to the angle at T, or to the distance, A T. Hence, by graduating it in hundreds and thousands of yards, the distance of the ship or fort, T, may be read directly from the galvanometer. One of these galvanometers is placed in the conning tower and one at each of the principal gun stations.

It will be seen from the illustration that the operator, on applying his eye to the telescope, has opposite to his mouth a telephone transmitter, a receiver being clamped to his ear. By this means the two operators are kept in constant communication and the errors are avoided that would be caused by the reading of a deflection produced before one or other of the telescopes is well directed toward the point to be observed.

[More complete descriptions of the Fiske range finder can be seen in back issues of the Review.]

Personal.—We understand that Mr. Fred. J. Satchwell has resigned his position as manager to Messrs. Mackey and Mackey, electric lamp makers, Bermondsey, having been appointed superintendent in Mr. Hiram S. Maxim's electrical laboratory.

CARBONISATION OF FILAMENTS BY ELECTRICITY.

By LEGH S. POWELL.

The idea of carbonising filaments by electricity, in lieu of the common furnace method, must have occurred to many. It was widely reported some 10 or 12 years ago that the remarkable "adamant" filaments, introduced by Woodhouse and Rawson, had been subjected to intense heat by electricity, but no details of the process employed were ever noised about, or reached the ears of the writer; and it is believed that at the present time the carbonisation of filaments by means of electricity has not been practically adopted. As the subject is not without interest or economic possibilities, it has occurred to the writer to be worth while putting on record an electric method he devised for this purpose about five years ago, and a few particulars of certain rough and superficial experiments which were made at the time at a Continental lamp factory to test its practicability. It is hoped that some incandescent lamp experts, who care to test the plan further, and who are able to bring together the means and conditions needed for the investigation, will succeed in bringing this process, or one allied to it, to a successful issue.

The features of the method in question and the principles involved, are very simple and obvious. The carbon blocks on which the cellulose threads are wound are conductors of electricity, and the plumbago powder in which they are packed is likewise a conductor. If a pile of blocks be therefore made with a layer of plumbago powder between each, and the whole be surrounded with suitable non-heat and electricity-conducting materials, whilst a current of electricity is made to pass, it is evident that the blocks will become heated, and grow hotter and hotter, until in time the filaments will be carbonised or "baked."

To bake filaments successfully by this method, it is naturally necessary to attend to several conditions. It is obviously of prime importance that the heterogeneous conductor be encased in insulating material of the best quality, and arranged in the most suitable manner. It is equally necessary to exclude the air, so as to prevent the burning of the filaments. Other considerations of more or less importance are: facility in packing and unpacking the containing vessel, the construction of the terminal conductors, the manner of applying the current, the duration of the operation, and the final cooling of the blocks.

As already intimated, the experiments that were made were in the nature of mere trials rather than a serious and persistent attempt to thoroughly ascertain the economic practicability of the method. Two experiments only were made; and as the notes taken of the dimensions, times, amperes, &c., were far from complete, and also by reason of the superficial nature of the trials, it is not proposed to describe them in detail. Suffice it to say that in the first experiment two parallel brick troughs were constructed on a brick platform covered with a layer of slag wool. The troughs, which were about a metre long, were packed with wound blocks, plumbago powder being sprinkled between each space. The current entered one trough by means of a stout terminal plate of carbon, flowed to the end, then across to the other trough by a long slab of carbon, and so on to the other terminal. The upper surface of the troughs was covered by slabs of earthenware, and the whole was surrounded with a thick coat of slag wool.

The current which was available for the operation had a pressure of 110 volts, and this factor was largely responsible for the arrangement of the furnace in manner described. The resistance cold was a little over 2 ohms, and the current at the start was 50 amperes. In an hour or so the current had risen to 150 amperes, when it was lowered to 50 amperes again by introducing an external resistance. At the reduced pressure the resistance of the circuit continued to decrease, and the current once more rose to 150 amperes.

On examining the filaments at the end of the operation they were found to be brittle and useless, a circumstance which was probably due to burning by access of air during cooling, to hasten which a considerable quantity of slag wool had been removed.

In the second experiment the length of the row of blocks was increased to about 3 metres in order more nearly to suit the current pressure; and instead of forming a simple $\pm\supset$ the course ran thus $+\supset\subset-$. To more effectually displace the air, a layer of plumbago powder, sprinkled with paraffin, was spread along the bottom of the troughs before charging them with the blocks. In this experiment the plumbago powder was more tightly compressed than in the previous one, the resistance cold being 3·8 ohms. For the purpose of raising the temperature more slowly at the commencement, an external resistance was included in the circuit, and the current adjusted to about 18 or 19 amperes. Instead of the resistance falling from the start, as in the previous experiment, it had a tendency to rise during about five hours. This increase, which amounted at the maximum point to about 25 per cent., may possibly have been due to the presence of the paraffin. By gradually cutting out the resistance, the current was caused to rise slowly to 25 amperes. In 10 hours from the start the current was only 30 amperes, in 12 hours it was 35 amperes, in 14 hours 55 amperes, and in 17 hours it had reached 65 amperes. The circuit was here interrupted for the night, but was again closed next day, after a lapse of 6½ hours, the current starting at 27 amperes. In six hours' time it once more attained 65 amperes. It is believed that the current was stopped soon after this, but the notes taken are not specific on the point.

The majority of the filaments obtained from this second operation were satisfactory in every respect, their flexibility and "colour" being good, whilst their resistance cold remained practically steady both before and after raising to incandescence in an inert gas.

The problem of baking filaments by electricity was allowed to drop, not because it was anticipated that the process could not be made to give satisfactory results, but principally because it was not considered to be worth while to arrange for a current of lower pressure and larger quantity to suit other and more convenient forms of apparatus, and also because it was supposed, by some, that the electric method would not prove to be more economical, or possess any striking advantage over the ordinary furnace plan. Without, however, ascertaining a good deal more thoroughly what degree of perfection can be attained, the data wherewith to form a sound judgment as to cost, &c., are not forthcoming.

To describe in detail the best manner of proceeding in order to construct suitable and efficient apparatus is not in the writer's power. Many materials and arrangements, however, naturally suggest themselves, and some of the more prominent of these may, perhaps, be mentioned.

It is patent that, in order to reduce the cost of the predominating item of expense, viz., current, to a minimum, it is imperative that the amount of matter surrounding the blocks, consistent, of course, with good heat insulation, should be reduced to utmost limit. In the experiments referred to, this condition was most imperfectly studied. A considerable mass of brickwork became heated to bright redness, at the expense of current, by contact with the blocks, and the extensive external brick surface was moreover very inadequately protected by the slag wool from the cooling influence of the surrounding air. The vessel in which the blocks are packed should, by preference, be either cylindrical or rectangular in form—the latter to suit the shape of the blocks—and of large enough dimensions, both in height and diameter, to be convenient for packing and unpacking the blocks. The vessel should stand in an upright position, and it should be made as thin in the wall as possible of a material which is practically impervious to air. Probably as good a material to use for the purpose as any would be the fire clay employed for making salamander crucibles. The vessel should be closed both at the top and bottom by a stout carbon plate or disc, the bottom one being cemented into position so as to admit no air at the junction with the vessel. The platform on which the vessel rests might, perhaps, best be made of the porous fire clay of which Fletcher's furnaces are made.

The question of how best to prevent the escape of heat at high temperatures is doubtless one in which a good deal of improvement might be made on attainments already arrived at, and it would form an interesting subject for investigation. Without possessing any special experience on the subject, the writer would propose that the vessel should be surrounded by two, three, or more (as may be found desirable) movable cylindrical covers of increasing dimensions, and made of the same material as the platform. Each cover, which must perforce have a small hole at the top through which the conductor, conveying the current, must pass, should be made as thin as practicable. The lower rims of the covers might fit into concentric grooves made in the platform, each groove being filled with powdered charcoal or lampblack. A series of air spaces would thus surround the vessel at regular intervals, and these would be likely to effect good heat insulation, whilst the actual mass of solid material employed would be reduced to a comparatively small cubical bulk. The arrangement would further possess the advantage of easily and expeditiously effecting the cooling of the blocks at the close of an operation by the simple removal of the covers or shades.

It may well be that better heat insulation and more conveniently arranged apparatus might be constructed on other lines. Many insulating materials packed round the vessel, such as asbestos, slag wool, lampblack, metallic oxides, &c., might perhaps be arranged to give excellent results. In the selection of such substances, it would be well to bear in mind the different specific heats which the various substances possess, although other properties and considerations may very likely far outweigh this one in importance.

All the world knows of the remarkable success which has attended Prof. Dewar in his experiments on liquid air and its preservation by means of exceptionally perfect heat insulation, effected by surrounding it with an intervening vacuum. The application of this principle to the form of electric furnace under discussion would doubtless be productive of highly successful results. The manner of constructing apparatus involving this principle is, however, not so very apparent, although it is a problem which would be well worth attempting.

Another principle, which might be made to give satisfactory results, would be that of heating the outside of the vessel by means of gas or otherwise, and so lessen the escape of heat generated by electricity. A loose outside fire-clay mantle might be arranged round the vessel, inside which gas was made to burn, or heated gases to circulate. The external surface of the case would not need such careful protection from the outside air, and the cooling down at the end of the operation could be easily effected. The total energy expended by this means of conservation of temperature would naturally be greater, but not necessarily more costly by reason of the difference in cost of heat produced by gas and that produced by electricity.

As regards the current needed for the generation of heat, it would doubtless be necessary to have the power of considerable variation of electromotive force. The amount of energy consumed would depend almost entirely upon the perfection of the surrounding heat insulation. With this very perfect, and with sufficient time, the temperature requisite for the proper carbonisation of filaments should be reached with a comparatively small current. The manner in which the current is applied and the duration of the operation to give the best results, are points which can only be determined by actual experience with any particular form of apparatus.

It may, perhaps, be idle to let the imagination run too freely on the advantages that are likely to result from the carbonisation of filaments by electrical means over methods of heating by fuel, before they have been actually demonstrated. Some advantages, however, are highly probable, and a few of them may be enumerated.

1. The wear and tear of the apparatus is likely to be appreciably less for the following reasons:—(*a*) There would be more regular heating and cooling of the apparatus; (*b*) there would be less lifting and moving about of the apparatus both in the heated and cold condition; (*c*) there would be an absence of fluxing material to destroy the apparatus.

2. The precision with which the current could be regulated ought to ensure greater uniformity in the quality and resistances of the several batches of filaments turned out in the regular course of manufacture. The defect inherent in the use of crucibles heated from an external source, due to the impossibility of heating equally all parts of the contents whilst raising the temperature would be wholly absent.

3. The labour needed to work the process would be of a much more agreeable and less arduous description.

In addition to these probable advantages, it is quite possible that the electric method might possess others of an important nature. The temperature of the furnace might be easily raised to a very high degree, and this condition might be conducive to producing filaments of a very dense and durable description. Further, by reason of the compact and isolated manner in which the apparatus might be arranged, it would be possible to perform the carbonisation under unusual physical and chemical conditions, such as in vacuo or under pressure in air or hydro-carbons, or other gases, by enclosing it in a suitable chamber. Such altered conditions might result in producing new and desirable results.

On the question of initial cost of apparatus and of the electric energy consumed, it will be prudent to venture no remark other than that both are likely to be in favour of electricity as compared with heating by fuel.

The electric furnace in various forms is now being employed in a number of industrial manufactures, both in the smelting of metals and in the preparation of substances such as carbide of calcium, graphite for electrodes, carborundum, &c., and there seems no reason why it should not be also successfully applied to the carbonisation of filaments.

ELECTRICAL ENERGY (GENERATING STATIONS AND SUPPLY).

(*Concluded from page* 638.)

At the sitting of the Joint Committee under Lord Cross on Thursday last week, Major Cardew, electrical adviser to the Board of Trade, said the Board of Trade regulations did not provide for the safety of the employés at generating stations, nor did they undertake any inspection. When, however, accidents had been reported to the Board, he had been instructed to inquire into the circumstances. As regarded general danger from high pressure, he did not think any danger could be apprehended by the public if laid in proper mains underground. In the case of overhead wires he was distinctly of opinion that danger increased with the increase of electrical pressure. In regard to interference with telegraphs and telephones, he considered that that could be avoided absolutely. Under the provisional orders of the Board of Trade, strong protective clauses were inserted. In the case of electrical powers for traction, where an uninsulated return was employed, some interference might be unavoidable. The clause settled by the Joint Committee should not be inserted in any Bill providing for general electrical power, since it permitted the use of uninsulated returns. The usual provisional order clause should be inserted. The Board of Trade sanctioned the use of the overhead system of electric traction in cases where no local objection was made. The danger to the public was not great. In 1889 the Board sanctioned a pressure of 10,000 volts for London, and that pressure had been in use since, without any injury to the public. He was quite satisfied that underground mains could be made perfectly safe.

The Chairman: You do not say the same of overhead wires?—Not at all. I am afraid that in the case of overhead wires there are possibilities of danger which can hardly be avoided altogether.

There have been accidents to employés?—Yes.

Can you suggest any regulations for their protection?—I think regulations could be made, and I have myself prepared some draft regulations; but it was rather a legal question as to how they could be protected, not being members of the public.

Mr. Kimber: Is the unsafety of overhead wires preventable?—I do not think you can say that it is entirely. We can make regulations, but in the event of these regulations not being entirely complied with at all times there might be accidents. Such things as gales and falling trees might affect the overhead wire which would not affect the underground wire.

What is the highest pressure which under any circumstances the Board of Trade will permit?—10,000 volts has been used.

Would they under any circumstances permit more?—I only speak as their adviser, and I think in some cases we should permit more in the case of underground wires. I do not think myself there can be laid down an exact limit beyond which it could be said the danger would become so appreciable that the thing should not be permitted.

Has any steps been taken by the Board of Trade to get statistical information with regard to the use of electrical energy in America?—We have not asked for information as to the working of these very high pressures.

Don't you think it would be advisable to do so; they are far in advance of this country in regard to the application of electrical energy?—In traction they are; I do not think they are in advance of us as regards the electric light.

Do you apprehend that there will be an increased demand for the use of power?—I think there will; I think it is coming.

You are aware that chemical works are being erected now in which as much as 4,000 horse-power is required?—Yes; that is a special industry which is kept very much to itself. The chemical industry opens a wide field for electrical energy.

Lord Balcarres: May I take it that your regulations have been sufficient to make it almost impossible for people who wish to carry energy to do it with overhead wires?—I should not have thought so.

Is it common in this country for energy to be carried overhead?—No; it is done in certain cases.

It would be cheaper to carry it overhead?—I do not think it would for any purpose of general supply. If you have to take off service wires to many different consumers work, with overhead wires would become impracticable.

But the same thing applies with underground wires?—There is a convenience for laying down a heavy mass of copper in underground mains which would be almost impossible overhead. The practice of the Board of Trade has been generally to discourage the use of overhead wires.

And you have been very successful in that direction?—It has not been much adopted.

By Mr. Ashton: He would not be prepared to advise any relaxation of the existing Board of Trade regulations for overhead wires.

The Chairman said that Mr. Kimber had asked for an answer to a question with regard to the price at which the Central Company of London had agreed to supply energy in bulk to the Westminster and St. James's Companies.

Mr. Balfour Browne: No price is fixed, but the basis on which it will be fixed is that in consideration of the two companies supplying the capital for and jointly promoting the Central Company, each shall be entitled to take as much energy as the other on terms to be agreed or otherwise settled, and that any excess taken by either company over what is taken by the other shall be paid for on the basis of the average cost price of the whole energy generated during the year, plus a reasonable profit.

Mr. Kimber: The effect would be that if the sliding scale principle of gas companies was applied to electric light companies, those companies would be able to make two profits?—No, I think not. If there is a difference as to what profit is to be allowed the Central Company, that is to be fixed by arbitration.

Mr. Pember, Q.C., then addressed the Committee, and said he appeared for companies whose interest it was to supply electricity for power and light inside their own districts. The main points he had to consider was, first, compulsory purchase, then power of breaking up the streets, power to supply within their district whether the local authority liked it or not, and even it might be in competition with the local authority. There were minor questions such as the sliding scale, notice to persons affected, and so on. As to the question of purchase, there had been evidence given of the great difficulty at present of obtaining land, and in the case of the Chelsea Company, the company were asked to buy adjoining property at a cost of over £30,000. That was but one instance of hundreds, which showed the necessity of having compulsory powers of purchase. He asked what real distinction there was between giving compulsory powers to railways than to electric lighting companies? but, of course, it went without saying that the lands should be specified. All that was necessary to be done in that regard was provided by the standing orders of Parliament now. It was perfectly clear that unless the compulsory power was given an individual could absolutely prevent the public enjoying in a particular locality the comfort and convenience of either electric light or electric power. Evidence had been given of the prohibitive prices put upon the only available sites, and there was also the nuisance clause, which interfered greatly with the supply. There was no doubt that it was shown from experience in the use of electricity that the nuisance clause was a mischievous one, and ought no longer to be left in the hands of any man. He would assimilate the practice of Parliament with regard to electric light with that of ordinary railway schemes. Each case should be considered on its merits, and Parliament should reserve all power to itself and not hand it over to any other body. With respect to notices being served on residents in the neighbourhood of land to be acquired for a generating station, that was a most expensive operation, and he contended that notice should only be given to the owner of the land, and that the local companies should receive notice and have a *locus standi* to object. If energy was to be generally available, it must be cheaply supplied, and if it was to be cheaply supplied it must be supplied in large quantities, and that meant by single undertakers in very large areas, and that again meant over the districts of several local authorities. There they were met by the jealousy of the local authorities, which applied to the sale to individuals within the districts. And next as to the breaking up of the streets. He asked the Committee to refuse to say that only the local authority should have an order in a district; but, of course, it would be for Parliament to pronounce hereafter as to any Bill. An absolute veto by the local authority should be removed, and he would give them a *locus standi* in place of veto. With respect to purchase, he saw the greatest difficulty in accommodating the power of purchase to local authorities for schemes for the supply of electrical energy over large areas. He would say, "Don't make an attempt to accommodate the present powers of purchase to undertakings in these large areas." In conclusion, he would suggest compulsory power of purchase, and the sweeping away of local veto with regard to the laying down of pipes and the general supply of energy for light and power. At the same time he would provide for a liberal *locus standi*, so that every case might be thoroughly well decided on its merits before Parliament, and every fact brought forward and every interest represented.

Mr. Balfour Browne, representing new companies desiring compulsory power for purchase of sites in order to supply in bulk, said he objected altogether to giving the local authority an absolute veto, either as to a site, or with regard to the breaking up of streets. He saw grave danger to the public in giving the authorities that power, and the result of their present powers with regard to tramways did not seem to be satisfactory. The consent of the local authority should be subject to an appeal to the Board of Trade; but the Board of Trade should not regard the opinion of the local authority as the

main consideration. At present it was true that the Board of Trade could dispense with the consent of the local authorities, but they never did so. The Board had such a respect for the local authorities, that in 60 cases he knew they had refused consent to companies. They had not the slightest objection to the local authorities undertaking the work; but what the local authorities were seeking to have recognised was a right in streets which they had not got by law. As to the conditions to be laid down on an electric light undertaking, such as he represented, he considered the powers of the local authorities were large enough at present. He asked what would be the condition of the gas and water supply had it not been for private enterprise. Local authorities would not touch such things unless there was a profit to be made out of it. At the present time electric light was not supplied in many districts, because it was known that as soon as a profit was shown, the local authority would step in and say it was time to purchase it. He asked the Committee to leave out the purchase question altogether in companies such as he represented.

Mr. Stevens said he represented the existing London companies other than the promoting companies. Following on an inquiry by Major Mandarin, the principle which had been acted upon was to confine a company to a definite area, and allow a limited competition. Speaking broadly, the endeavour of the Board of Trade had been to secure in every district two companies and no more. It was a remarkable fact that there had been an entire absence of evidence before the Committee that the present system had given cause for complaint. The further development of electrical energy could only be effected by the mode in which Parliament dealt with those who had already invested their money. He agreed that there should be compulsory power of purchase, and that an existing company should have power to go outside its area for a site for a generating station. But it was also asked that new companies should be allowed to come into a district and supply anywhere free entirely from the conditions imposed upon the existing companies. That was a distinct revolution in the principles which had heretofore been applied. If it was agreed that those new companies should be exempt from purchase, it would be the commencement of a new system diametrically opposite to all Parliament had already done.

Lord Cross: Do you contend that under the existing system the development has been all we could wish, and that we are bound to this system?—No; all I ask is that whatever is done shall not be unfair to existing companies.

Mr. Worsley Taylor addressed the Committee on behalf of a number of Corporations, who, he said, were largely interested in the matter, for local authorities had invested 3½ millions of money in electrical enterprises. On the question of compulsory purchase the Corporations were entirely in agreement with the companies, for it was as necessary to the Corporations as the companies. On the question of nuisance they were also in agreement. On the question of the control of the streets, that was the matter with which the Corporations were most vitally interested. *Primâ facie*, it should be admitted that there should be a perfect control over the breaking up of the streets by the Corporation, but it should be subject to appeal to the Board of Trade. Then assuming their consent was dispensed with, they should have power over the route and the way the work was to be carried out, and they should have power to undertake the work themselves.

Mr. Coward, representing the London County Council, contended that the Council differed from all other authorities inasmuch as they were the controlling authority over the electric lighting companies, whereas the vestries were the local authorities. Under these circumstances they contended that the Council was the authority in whom the ultimate power of purchase should be vested.

This concluded the evidence and addresses, and the Committee adjourned till Monday for the consideration of their report.

The further sittings will be private.

LONDON COUNTY COUNCIL.

At the weekly meeting on Tuesday the following electrical matters were considered:—

Transfer of Lighting Powers.

Mr. B. F. C. Costelloe (chairman of the Local Government Committee) obtained the sanction of the Council to the postponement of the report of the Committee in regard to the recent conference with representatives of the London vestries and district boards to consider what powers now vested in the Council should be transferred to those local authorities. That portion of the report of interest to our readers is as follows:—

"The Conference proposed: 'That the powers of the Council under Electric Lighting Provisional Order Confirmation Acts, as regards the appointment of inspectors, provision of testing stations, and exercise of powers with reference to price and energy of the supply of electricity in a district, should be transferred to the local authorities.' We are of opinion that it is most essential that these powers should be exercised by one authority, having regard to the additional cost that would of necessity follow a transfer of the powers to the local authorities, in connection with testing stations and plant, and also having regard to the necessity of a general supervision and uniformity of treatment in these matters which involve more than local interests. We recommend that the powers of the Council under Electric Lighting Provisional Order Confirmation Acts, as regards the appointment of inspectors, provision of testing stations, and exercise of powers with reference to price and energy of the supply of electricity in a district, be not transferred to the local authorities."

"The Conference proposed: 'That power should be given to local authorities to alter or remove overhead wires in their districts in the event of the company refusing to do so.' We are of opinion that the London Overhead Wires Act, 1891, already gives to the local authorities all the powers sought for by the resolution."

London United Tramways.

The Highways Committee reported that, by the London United Tramways Bill, it was proposed to repeal Sections 17 to 28 of the London United Tramways Order, 1895, relative to the use of mechanical power, and to authorise the use of electric traction on the whole of the company's system within and without the County of London. The Council, whilst it had not offered objection to the conduit system, had consistently refused consent to the introduction of the overhead system, and had therefore petitioned against the London United Tramways Bill. In this connection the Highways Committee stated that they proposed that evidence in support of the Council's petition should be given by Mr. Baker (vice-chairman of the committee), by the chief engineer, by the chief officer of the fire brigade, and by an expert, whose evidence should be specially directed to the practicability of using the conduit system in London in conjunction with an overhead system, if established, on the company's lines outside the county. The Committee accordingly recommended that the Parliamentary Committee should take the necessary measures for supporting the petition against the Bill in the manner suggested. This recommendation was also opposed, and having passed the time limit was accordingly adjourned.

The Telephone Question.

Pending the report of the Government Select Committee on Telephony, the Highways Committee expressed the opinion that it would not be well for the Council to proceed further with reference to the proposed agreement with the National Telephone Company in regard to the conditions under which permission had been given in certain cases for the placing of telephone cables underground. The Committee thought, however, that as under the conditional consents the company had executed certain works, the company should be required to enter into an agreement embodying certain conditions in regard to the works already carried out. The Committee, therefore, recommended that the telephone company should be requested to enter into an agreement undertaking (1) to alter any telephone line if and when required by the Council, and (2) that if and whenever the Council desire to adopt electric traction on any tramway belonging to or leased by or under the control of the Council, which passes along any street or part of a street in which any line of the company is laid, the Council may require the company to alter any such line, or portion of such line, or to remove the same to such position as the Council may require, and thereupon the company shall, without any claim for compensation against the Council or its lessees, proceed to make such alteration in the position of such line as no earth return but a complete metallic circuit is provided and used, the Council or its lessees shall not be liable to the company for any interference with, or prejudicial effects produced upon, the cables or wires or the working of the same, or upon the operations of the company, by reason of such use of electricity upon such tramway.

Transformer Boxes.

The County of London Electric Lighting Company having given notice of intention to construct 15 transformer boxes in Camberwell, the Highways Committee reported that the works mentioned in the notice were a repetition of those works which were expressly disapproved by the Council on January 25th. At that time the appeal of the same company to the Board of Trade against a previous decision of the Council, disapproving the construction of certain other transformer boxes proposed to be constructed by the company, was pending. The Board has since then, however, allowed the appeal, and authorised the company to construct the transformer boxes referred to, subject to the usual conditions. This decision was reported to the Council on March 29th last. The Committee were of opinion that, in view of the Board's decision, the Council could no longer withhold sanction to the construction of the transformer boxes referred to in the present notice; and should the Council adopt the alternative course of making no order with reference to the notice, the company could proceed with the works without any restrictions. The Committee therefore recommended, and the Council resolved, to conditionally approve the construction of the transformer boxes in question.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. Leonard Andrews, the engineer and manager of the Hastings Electricity Works, had an opportunity of describing the latest form of his alternating current non-return or discriminating switch and its uses at a meeting of the Institution of Electrical Engineers on Thursday of last week. The paper, entitled "The Prevention of Interruptions to Electricity Supply," was read in the hall of the Society of Arts.

Our readers will remember the description we gave nearly two years ago of the switch gear in the Hastings station, when the earlier pattern of the Andrews switch was illus-

trated and described. Mr. Andrews has also given a full account of the device in a paper read before the Northern Society of Electrical Engineers last year. The present pattern of the arrangement differs from that before published in its mechanical details, the principle remaining much the same.

Mr. Raworth opened the discussion, and reminded his audience that he was a bit of an inventor in the field of discriminating switch gear himself. He could not allow himself, however, to say anything to detract from the credit due to Mr. Andrews by taking honour to himself who had done so little. Mr. Andrews had, he thought, hit the right nail on the head by using such discriminating fuses on interconnecting links on the distribution system. It was well known that when a generator went wrong it caused the fuses on the good machines to burn down first, and an example of this had occurred in the City of London station, where, on one occasion, every fuse in the station had gone, and the lights were all extinguished.

Some years ago Mr. Raworth designed a discriminating fuse arrangement, which was described in our columns. It was based on the principle of two paths for the current; a little transformer sucked current through one of these, which formed a bye-pass to a thermal fuse-wire, when the energy was passing out; but when a reversal of flow took place, the transformer caused the current to be diverted through the fuse, which melted and opened the circuit. Much time and money was spent on this device, and at last it was got right; but the time element interfered with its utility, as the time taken by the fuse to melt was often sufficient for the machine to burn out.

Mr. Andrews had done well to go in for the mechanical arrangement, and had shown very great ingenuity in carrying it through a great variety of alterations in detail design, until at last it had reached the form exhibited. Its great merit is that it can't be joggled into working, but must be tickled. While some engineers will say, "Oh! we have no interruptions to our supply," an apparatus of this kind may be termed an apparatus for relieving the mind of the electrical engineer from anxiety. Even with machines of large self-induction there is another point to consider; one cannot always guarantee or be sure that a fault will come on in the end coils, and if an intermediate coil proves faulty, the self-induction of a few will not cut the current down materially. The switch had been tried under very trying conditions, and large currents could be broken under water without appreciable spark. Mr. Raworth thought he had designed more switches than any other living man, but he was not going into competition with Mr. Andrews on this switch, which he congratulated him upon as not merely a switch or fuse, but a device which had been worked out into a system.

Mr. Chattock thanked the author for his paper, as he had made one or two attempts at a similar switch himself, and hoped this summer to perfect. All station engineers would confirm what Mr. Andrews had said as to the unreliability of fuses. This switch meets the necessity of the case. With regard to fig. 7 of the paper, a short-circuit on the connecting main between the two sub-stations would be likely to blow both feeder fuses. Mr. Andrews afterwards explained that he would in practice place thermal fuses at each end of this connector.

Mr. Lawson did not go so far as Mr. Andrews would go, as he thought it undesirable to have any sensitive mechanism, and on switching on the switch might give trouble. With reference to double feeders to sub-stations, he thought this very reliable, but rather expensive. He also was of opinion that some of the saving in the Hastings coal bill might reasonably be attributed to an improved load factor. In his reply, Mr. Andrews pointed out that while the coal per unit might go down from this cause, it could hardly be expected that the *total* coal bill would be diminished.

Mr. Raphael believed that while Mr. Andrews suggested that consumers' fuses should blow only at 300 per cent. overload, the fire insurance offices would insist upon a lower figure. He considered that leakages to earth and "shorts" should be dealt with in different ways, and to guard against the considerable danger that might arise from the flow of a leakage current of only a few amperes, he had devised an arrangement which would cut off the wiring from the supply where an iron pipe conduit system was installed. This consists, briefly, of a fuse in the earth wire to the metal conduit. On the fuse melting by leakage current, a lever is let go, which falls and short-circuits and earths the wiring blowing the house fuses. There was, however, no chance of this system being adopted, as it would cost a few shillings, and in these days of cut prices contractors were not inclined to take up anything that would increase the price of work. Even without such safeguards, any system of wiring is a better risk for insurance companies than gas.

Mr. Bathurst reiterated certain arguments in favour of the adoption of electric-proof pipes or insulated conduits, which are probably not new to the majority of our readers, although ably put by the speaker.

Mr. Weekes drew attention to the want of novelty in the principle of non-return or discriminating devices, and showed that such had been in use with continuous currents for some years, while Mr. E. K. Scott was understood to animadvert upon the design of certain of Mr. Raworth's switches and the troubles out of which the City Company have passed.

Prof. S. P. Thompson, who occupied the chair, pointed out that there is a long step between discriminating devices for continuous and alternating currents, that the wattmeter may be used—as Mr. Andrews practically does—to *discriminate* with alternating currents. While the apparatus confers a benefit on alternate current workers, a machine should not come to pieces if "shorted," or put in out of phase, and closed his remarks thus: "A fuse is a very excellent thing to do without."

Mr. Andrews replied by saying that his switch was just the thing for synchronising in a hurry; that one never knew what fuses would do; a circuit cannot be opened too quickly, and that often a short occurs which is not a case of two pieces of copper coming together. His extended remarks, delivered with enthusiasm of his subject, formed a further exposition of the interesting subject, and the meeting closed with a general feeling of gratitude to Mr. Andrews for a good discussion.

CORRESPONDENCE.

Ether and "Surface" of Matter.

A great many phenomena are endeavoured to be explained by motions of or in the ether. But considerations in regard to a decrease or increase of *surface* in changes of configuration of or in matter, appear not to be sufficiently appreciated in reference to motion, energy, &c. But it may be taken that wherever energy, so-called, in any form, is given out from any system of matter, that system must diminish in *surface* and *vice versâ*. It does not matter whether the mass under consideration be the sun, a watch-spring, ions, or what not, a simple or complex molecule, or the visible universe.

In some mysterious way the organs of our bodies appear to absorb and give out energy by such a change of surface. In fact, it is not by any means difficult to explain much of the phenomena of life and death by it. Most certainly thermal and electrical phenomena in chemical change can be explained on this basis. If the particles of any two or more bodies have together greater surface before combustion, association, combination, &c., than afterwards, then there will be a rise of ether pressure or potential or moving power upon the resultant matter surface.

The total change in *surface*, and the rate of increase or decrease of such change in surface, will explain and render clearer a great many thoughts about matter and motion. However, if we accept the idea of matter in all forms being charged (on its surface) with another something which we call the ether, then we should have no difficulty in imagining how, by a change in *surface*, there will be an *in*-rush or *out*-rush of this ether, which we may express by − or + sign respectively. *Surface* seems to be the key to it all. Tyndall asked (1862): "*May not the condensed ether which surrounds the atoms be the vehicle of electric currents?*" But if atoms dissociate [we must also suppose the ether itself capable of association and dissociation—Maxwell had the idea in his mind of a molecule of electricity] as to increase the surface,

there will be a fall in the density of the ether, and if they associate (or aggregate) as to produce a decrease of surface, there will be a rise in the density of the ether, which may have explosive or gentle expansive *force*.

J. C. R.

London, *May 10th*.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending May 10th, 1897.	£	s.
Albany	297	0
Amsterdam	225	0
Antwerp. Elec. fuses	361	0
Bangkok	772	0
„ Teleg. mat. ...	913	0
Beira	64	0
Bilbao	14	0
Bombay...	438	0
„ Teleg. mat....	46	0
Brisbane. Teleph. mat.	721	0
Brussels	1,230	0
Calcutta...	194	0
Cape Town	10	0
Colombo	322	0
Copenhagen. Teleg. wire	17	0
Durban	986	0
„ Teleg. mat. ...	179	0
East London	98	0
Galveston	8	0
„ Teleg. cable	2,800	0
Genoa	300	0
Hamburg. Teleg. mat.	1,229	0
Hong Kong	25	0
Madras	96	0
Marseilles	163	0
Mauritius. Teleg. mat.	120	0
Melbourne	61	0
Nagasaki. Teleg. cable	25,000	0
Passages	1,710	0
Port Elizabeth... ...	130	0
Shanghai	823	0
„ Teleg. mat....	80	0
Singapore	51	0
„ Teleg. mat.	332	0
Sydney	314	0
Trieste. Teleg. mat. ...	330	0
Trinidad	13	0
Vigo. Teleg. mat. ...	268	0
Wellington	25	0
„ Teleg. mat.	2,471	0
Yokohama	150	0
Total ...	£43,386	0

Week Ending May 10th, 1898.	£	s.
Algeciras	35	0
Amsterdam	235	0
Antigua. Teleg. mat....	11	0
Antwerp	32	0
Auckland	690	0
Bermuda. Teleph. mat.	10	0
Boca	16	0
Bombay	65	0
Boulogne	27	0
Buenos Ayres. Telep. mat.	20	0
Calcutta...	26	0
Cape Town	289	0
Colombo	236	0
Delagoa Bay	44	0
Dunkirk	15	0
Durban	437	0
East London	725	0
Fremantle	671	0
Halifax	500	0
Lisbon	80	0
Madras	88	0
Malaga	90	0
Melbourne	30	0
Port Elizabeth... ...	87	0
Rotterdam	35	0
St. Petersburg	85	0
Shanghai	190	0
Singapore	10	0
Spezzia	822	0
Stockholm. Teleg. mat.	118	0
Sydney	818	0
Wellington	327	0
Yokohama	100	0
Total ...	£6,964	0

Foreign Goods Transhipped.

	£	s.
Calcutta. Teleg. mat....	75	0
Port Elizabeth... ...	38	0
Total ...	£113	0

	£	s.
Alexandria. Teleph. mat.	73	0
Barcelona. Electric tram plant	10,600	0
Malaga	276	0
Stockholm. Teleph. mat.	22	0
Total	£10,971	0

Books Received.—"Science and Engineering, 1837-1897." By Chas. Bright, F.R.S.E. Pamphlet, 24 pp., published by Messrs. Archibald Constable & Co., 2, Whitehall Gardens.

"Industrial Electricity." By A. G. Elliott. (Translated and adapted from the French of Henry de Graffigny. Published by Whittaker & Co., London. Price 2s. 6d.

"Alternating Currents of Electricity, and the Theory of Transformers." By Alfred Still, A.M.I.C.E. Published by Whittaker and Co., London. Price 5s.

Catalogues and Lists.—Messrs. Wimshurst, Hollick and Co., of Commercial Road, E, who have offices at 17, Victoria Street, S.W., send us a 16-page pamphlet in which the general utility of electric cranes and lifting gear is demonstrated. The letterpress shows that cranes driven by electric power and fitted with Hollick's patent gears and motors, are cheaper in first cost, in repairs, and in working, than cranes worked either by steam or hydraulic power. Some comments are made upon the general efficiency of cranes, and illustrated descriptions are given of Hollick's patent balanced friction gear electric overhead travelling crane, electric goods lift and warehouse crane winch, also of electric cranes in use at the West India Docks, and at the wharves and works of firms in different parts of the country.

The Nottingham Engineering Company, Limited, of Radford, Nottingham, have issued an illustrated catalogue of shafting, bearings, couplings, and other fittings, together with a cipher code for ordering by telegram. In tabulated form there are given sizes of shafting required for a given horse-power, and the number of revolutions; also graduated price lists, covering many pages, of bright turned steel and iron shafting. A great number of power transmission accessories, couplings, wall boxes, plummer blocks, brackets, hangers, pulleys of various kinds, &c., are included in this list.

Messrs. Heath, Snoxell & Co., Limited, of Birmingham, have issued a handy pocket list, which is a photographic reproduction, considerably reduced, of their larger catalogue, giving particulars of electric motors for all purposes, and dynamos for electric lighting stations, transmission of power, and electro-deposition of metals. There is a specification of standard continuous-current dynamos, also illustrations and tabulated details and prices. Prices and general particulars of motors, and ammeters and voltmeters are given.

Messrs. Chas. Jennings & Co., of 90, Cannon Street, E.C., have issued an illustrated list of isotropic iron magnet forgings and armature stampings, steel magnet castings, and transformer stampings. The results are given of some tests made by Prof. Ewing on steel magnet castings which were manufactured for Messrs. Jennings. This firm is also sole representatives for the United Kingdom of the extensive copper works known as the Usines Mouchel, Boisthorel, France, and, therefore, high conductivity copper is included in the list.

The Crystal Electric Lamp Company, Limited, v. Pearson.—This was a claim made by the plaintiff company at the Lord Mayor's Court last week to recover from the defendant, Mr. A. Pearson, a sum of £20 4s. for electric lamps supplied. The defendant said that a half-brother of his (Mr. Bundy) and a Mr. Roe started the business of the Decorative Glass Company. He had ordered the goods of the plaintiffs for that company, and had afterwards given the authorisation, on the condition that he should either receive the balance of the electric lamps or be given an authority to collect the accounts due to the plaintiffs for the lamps. The plaintiffs would do neither, and therefore he declined to pay for the lamps supplied. The jury found a verdict for the plaintiffs.

Electrical Exhibits in Manchester.—Messrs. F. H. Royce & Co., electrical engineers, Manchester, have supplied the dynamo and lamps for the fairy fountain at the Brewers' and Allied Trades Exhibition now being held at St. James's Hall, Manchester. They have also, at Stand No. 74, an exhibit of the transmission of power by electricity. The National Gas Engine Company exhibit a small electrical installation consisting of one 5-H.P. brake National special high speed electric light engine, with various fittings, and driving dynamo. They have also specimens of electric light lamps and fittings. An electric piano is shown by Messrs. Guldman, Market Street, Manchester.

Electricity in Cork.—The Cold Storage Company, Limited, have decided on getting rid of their gas engines, and in a very short time electric motors will replace them. The order for the motors was given to a local firm.

Embezzlement.—L. A. Longley, accountant, was charged at the Guildhall Police Court, last Saturday, with embezzling £4 11s. received by him on behalf of his employers, the Electric Light Insurance and Maintenance Company, Limited. Prisoner blamed his betting habits. He was remanded.

Forthcoming Book.—Messrs. Emmott & Co., Limited, have in preparation an entirely new work by Mr. C. N. Pickworth, Wh. Sc., entitled "The Indicator Handbook: a Practical Manual for Engineers."

The "Ideal" Engine.—Messrs. Daniel Adamson and Co., of Dukinfield, near Manchester, have brought out an exceedingly neat list in the American style, of their "Ideal" high art engine. This steam engine, which is described and well illustrated, is automatic and self-oiling, and is said to be specially adaptable for direct connection, because of its range of speeds, quiet running, absolute regulation, perfect balance, compactness, and automatic lubrication. The advantages claimed for the "Ideal" engine are briefly stated, and there are some general remarks on the importance of good lubrication. The "Ideal" tandem compound engine is described, and there are some comments on the economy in compounding, also on the governor and the "Ideal" throttle valve. Tables of dimensions and powers of the engines are given. The list has been very well put together. Mr. Frank Jordan, of 15, George Street, Mansion House, E.C., is London agent for Messrs. Adamson.

Langdon-Davies Motor.—The increased facilities for manufacturing now available at the new works of the Langdon-Davies Motor Company, referred to in our last issue, have already enabled them to effect a reduction in prices, particulars of which are given elsewhere.

Private Telephone Systems.—Mr. R. S. Blackburn is putting in an extension of the Long Eaton Co-operative Society's telephone system, connecting various additional branches with the head shop. He is erecting a system of fire and ambulance telephone call stations for several out-districts and 14 firemen's houses for the Urban Council of Long Eaton, and is also laying down a complete telephone system for the Blackley Co-operative Society.

Reavell v. Brotherhood.—This was an action brought before Mr. Justice Grantham and a special jury by Mr. William Reavell against Mr. Peter Brotherhood to recover damages for wrongful dismissal and for breach of contract. Mr. John F. P. Rawlinson, Q.C., and Mr. Whatley (instructed by Mr. Percy J. Nichols) appeared for the plaintiff, and Mr. Bucknill, Q.C., and Mr. Alfred Lyttleton (instructed by Messrs. Cope & Co.) for the defendant. Mr. Rawlinson stated that the action had been settled on the terms of the defendant paying to the plaintiff the sum of £1,000 damages and costs (in addition to the sum of £519 4s. already paid into Court), the defendant also fully withdrawing all charges of every kind pleaded as a justification for the dismissal of the plaintiff. Mr. Bucknill for the defendant assented.

The Shannon Power Scheme.—The proposals of the Shannon Electrical Power Syndicate were again before the Shannon Fishery Conservators last week. Mr. Fuller, the engineer, submitted a tracing showing the proposed canal. Various questions were drawn up for the syndicate to answer in regard to the general details of the undertaking.

The Smoke Nuisance.—There has been a correspondence on this subject in the *Westminster Gazette*. One writer says that ever since the South Wales coal strike commenced the big chimneys of the electric lighting works in East Street, Manchester Square, and Davies Street, Grosvenor Square, have been vomiting forth—both by day and by night—volumes of the blackest and foulest smoke.

South African Electrical Notes.—The May issue of the *British and South African Export Gazette* contains the following items of electrical interest:—

A trial indent of 12 sets of railway carriage electric lighting apparatus has been placed with Messrs. J. Stone & Co., Deptford, S.E., by the Cape Government Railways, to be followed by the necessary orders for a general introduction of these fittings should the experiment prove successful.

The Kimberley electric lighting scheme having been approved, orders may shortly be expected to be placed for the needful material.

Tenders for arc lamps and insulated cable were called for last month by the Johannesburg Town Council.

The electrical motor driving the central mill at the Transvaal Gold Mining Estates Mine having completely broken down, the order for a new motor in substitution for it will be immediately placed.

A power plant has just been installed at the York Gold Mine, comprising two belt-driven 50-H.P. three-phase inductor type generators, running at 750 revolutions per minute and supplying power to two 24-H.P. motors coupled to belt-driven pumps; also a 3-H.P. motor connected to a centrifugal pump; and several small motors for various kinds of machinery, including one of 9-H.P., coupled direct to a continuous current dynamo of 15 volts 300 amperes output, for cyanide work.

An electrical plant recently sent out to the Vogelstruis Gold Mine by the General Electric Company, Manchester, consisted of two 150-k.w. three-phase generators, belt-driven at a speed of 300 revolutions per minute, a frequency of 30 cycles and a pressure of 950 volts; three triplex single-acting pumps, with plungers 6½ inches by 8 inches, coupled direct to 35-H.P. motors, running at 360 revolutions.

The generators of the General Electric Power Company, Johannesburg, were made by Messrs. Brown, Boveri & Co., Baden, Switzerland, and their fly-wheels by Messrs. Yates and Thom, Blackburn, the shafts of the fly-wheels being supplied by an American firm.

An electric lighting plant, manufactured by Messrs. Thomas Parker, Limited, Wolverhampton, has been installed at the British South Africa Mills, Bulawayo.

Spain.—The *Consular Journal* says that although the demand for cables and other electric appliances is increasing in Spain, English manufacturers are not benefiting at all by it. An opening for a large supply of water, electric light, and gas, materials will be afforded by the proposed formation of a company to provide the town of Oviedo with water, electric light and gas, for a term of 99 years. The capital has been already subscribed.

S. Z. de Ferranti, Limited.—Messrs. S. Z. de Ferranti, Limited, late of Charterhouse Square, London, have now transferred the manufacture of meters to their new works at Hollinwood, Lancashire. The London works are closed, but a depôt has been opened at 29, St. John's Square, Clerkenwell, for dealing with their meter business in London and the South of England. All communications for that district should be addressed to St. John's Square. The remaining business will be dealt with from Hollinwood.

The "Underground."—We have received a small leaflet by Mr. Ernest Callard discussing the question of the ventilation of the Metropolitan Underground, which has been receiving so much attention lately.

ELECTRIC LIGHTING NOTES.

Alloa.—The Alloa Public Baths and Gymnasium, which Mr. John Thomson Paton has just handed over to the town of Alloa, is fitted up with electric light throughout. The work was carried out by Messrs. Mavor & Coulson, Limited, whose patent concentric water-tight system has been installed.

Bath.—The new generating plant is ready to be put in position as soon as the building contract is completed. Seventy-five of the new arc lamps have been fixed.

Belfast.—When the report of the Electric Committee came before the Corporation last week, it was stated that the engineer had reported that the Acme Gas Engine Company had refunded £1,593 5s. 6d. in respect of the three engines which were to be returned. The Town Clerk said the Acme engines were not found to come up to the undertaking given by the company, and it had been agreed to take them back and repay the money. There was a passage in the report relating to the subject of electric traction, but Councillor Andrews was absent. The matter is under consideration. The engineer reports that for the past quarter's working, there was an increase in the receipts of about 50 per cent., and an increase of the output of about 55 per cent., as compared with the corresponding period of last year.

Bloemfontein.—Definite conclusion is about being come to, says a London contemporary, with regard to the long-mooted electric installation for the Orange Free State capital. According to last advices, it has now been decided to submit the plans and the several tenders to an engineer in Europe for report. The tenders sent in varied in amount from £12,000 to £30,000.

Bournemouth.—At the Town Council on Wednesday last week it was recommended by committee that the Council should generate the electricity necessary for lighting the pier, pleasure gardens, and winter gardens, and invite tenders. The town clerk stated that in 1895 the Local Government Board gave sanction for the borrowing of about £4,500 for the purpose, any amount decided on to be repaid within seven years. The Board had now written asking if anything had been done by the Corporation, and if not, and the Council did not propose to act on it, that the sanction should be given up. The scheme the Committee recommended was to take up sanction to the amount of £1,600 for the material and wiring, and £900 for generating electricity, and the surveyor had prepared a scheme to utilise the present pumping stations and light the pier, winter gardens, and pleasure gardens; but the sum would have to be repaid in three years, that being the limit of the original period of sanction. The scheme was agreed to after a discussion on arc *v.* incandescent lights. The tender of Messrs. Cash, Robinson & Co. was accepted.

Bridlington.—The Council has resolved to light the parade on Sunday nights with gas instead of electricity.

Cardiff.—Complaints have been made to the Lighting Committee of alleged erratic measurement of the current, consumers considering that they are charged for more than they use. The Lighting Committee is referring the matter to a Local Government Board inspector, and is writing to other towns to know whether similar complaints are made there.

Cheltenham.—The minutes of the Lighting Committee which were adopted by the Council last week, state that the electrical engineer reported that the new steam alternator, No. 6, had been started, and had run very satisfactorily for about 10 days on the town mains; the buildings were nearly complete, and he hoped to get the battery of accumulators into place shortly. He recommended that a small part of the extension to the arc lighting mains included in his estimate of extensions in February should be carried out, at a cost of about £120. In consequence of two faults on high pressure cables on Saturday evening, the 16th ult., the town supply was interrupted for periods of eight and 18 minutes respectively, at about 7.20 p.m. and 10.50 p.m. The earlier fault was due to breakdown of a rubber insulated cable forming a service in Lansdown Terrace, and the second fault occurred on one of the two main feeders and at the junction of the St. George's and Gloucester Roads. At this place the cable had been several times disturbed by openings made by the gas company, and the Highways and Waterworks Departments, and he thought it likely it had suffered some rough usage; the fault, however, was very much burnt up, and at that time he could give no definite opinion as to the cause of the trouble. Both faults had been repaired. The estimate of expenditure on street lighting for the current year was £3,750 for gas and £2,550 for electric lighting—total £6,300.

Chiswick.—The District Council last week passed the following resolution:—"That a statement of the dealings of the late District Council with the Bourne and Grant Electricity Supply Company, Limited, and a copy of the correspondence between the said parties, together with a copy of the agreement originally entered into, be supplied by the clerk to each member of the present Council and also to the public press, and that all necessary steps be at once taken to re-acquire the electric lighting power of the parish."

Conisborough.—The Parish Council will oppose the General Power Distributing Company's scheme.

Country House Lighting.—According to an Aberdeen paper, Mr. George Farquharson, of Whitehouse, has just utilised the water-power which has been hitherto running to waste on Donside for electric lighting purposes. A pipe conveys the water down the hillside to a turbine which drives the dynamo. Every part of the mansion house is lighted electrically, and the long winding avenue is also illuminated by lamps hung from the trees. During the day the current will be used for driving the threshing mill, corn-bruising machine, turnip and chaff cutters, &c. The turbine house is about 100 yards from the mansion house. The electrical work was carried out by Messrs. Middleton & Co. The dynamo was supplied by the Electric Construction Company, and the turbine by Messrs. W. Günther & Co.

Coventry.—The quarterly statement of the Corporation Electric Light Department shows a considerable advance upon the corresponding quarter last year. The amount of current supplied was 30,090 units, as compared with 21,516 during the same quarter last year. The rentals amounted to £891 4s. 5d., as compared with £547 6s. 5d., while the number of consumers increased from 76 to 112.

Clay Cross.—The District Council is considering the scheme of the General Power Distributing Company. There is a good deal of feeling in favour of the proposal, but the matter is to be investigated by the Highway and Lighting Committee.

Devonport.—An offer to provide the town with one of Willoughby's refuse destructors, capable of dealing with from 70 to 100 tons of refuse per day, has been referred to the Sanitary Committee, with the assistance of the Electric Lighting and Tramways Committee. If the destructor is approved, it could be purchased at the end of three months for £2,000.

Dundee.—The Town Council last week unanimously passed the recommendation advancing the salary of the borough electrical engineer, Mr. Tittensor, by £50 per annum. There was a general discussion in the Council, on the suggestion of the engineer that lamps should be placed in certain streets, and it was moved that the engineer should draw up a big scheme, embracing the central and principal streets of the town. It was stated by others that they had already had a big scheme from the engineer, which was delayed until the tramway question was settled. The proposals for lamps to be put up in certain streets were referred back to the Gas Committee.

The electricity rental during the past year came to £6,279 odd, an increase of £736 odd compared with the previous year.

Eton.—The District Council has appointed a Committee to obtain information *re* electric lighting from other towns.

Fulham.—We understand that at last week's Vestry meeting the Electric Lighting Committee recommended the appointment of Mr. F. H. Medhurst as consulting electrical engineer.

Germany.—The United States Consul at St. Gall, in a report to his Government, states, according to the *Board of Trade Journal*, that in the following cities in the German Empire the municipal authorities own and manage the electric works that supply light and power: Bremen, Barmen, Cassel, Darmstadt, Düsseldorf, Elberfeld, Hanover, Cologne, Königsburg, Lübeck, and Pforzheim. All of these cities, with the exception of Hanover, also own the gas works. The following cities have constructed the electric works for the purposes of light and power, but have leased the management of the same to private operators: Aix-la-Chapelle, Chemnitz, Frankfort, Strasburg, and Stuttgart, all of which, with the exception of Chemnitz, are cities where the gas works are under the management of private corporations. In the following cities, private companies have established electric works with the agreement that, under certain conditions, the municipal authorities shall have the privilege of securing absolute control and ownership by purchase: Altona, Dessau, Gera, Hagen, Heilbronn, Leipsic, Mülhausen, Stettin, and Zwickau. Of these cities, the gas works are under private control in Dessau, Hagen, Mülhausen, and Zwickau.

Glasgow.—The Electricity Committee last week generally approved of the report, mentioned in our last issue, recommending a large electric lighting scheme, involving half a million expenditure, for the municipal area.

Glossop.—The Town Council is engaging a Manchester engineer to report on an electric light scheme.

Godalming.—On Tuesday last week a Local Government Board inquiry was held with reference to the Council's application for a £1,500 electric lighting loan. Evidence as to the scheme was given by Mr. Cousins, electrical engineer, representing the firm of Kincaid, Waller & Manville, and the Mayor and other residents spoke in favour of electric lighting, and stated that the gas was at present bad, and much too dear. The town clerk explained that a station site had been purchased for £400 near the pumping station. The number of lamps within the compulsory area is 32.

Govan.—The Police Commissioners have adopted the recommendation of the Electric Lighting Sub-committee that steps be taken to put the electric lighting powers into force, and the matter has been referred back to the Committee to consider and advise as to system, site, and other details. It was considered that an electric supply undertaking was a municipal necessity.

Hampstead.—On Thursday night last week, for the first time, the lower part of Heath Street, with High Street and Haverstock Hill, were lighted with electric arc lamps. There will now be a straight continuous line of arc lamps from the fire station to Oxford Street.

Hastings.—The electric light machinery for the Corporation works at Waterworks Road is in working order, and the requisite one month's notice has been given to to the Hastings Electric Light Company of the desire of the Council to determine the existing agreement with the company for the lighting of the electric lamps on the front line. The Public Lighting Committee has reported to the Council that the Board of Trade had issued the provisional order authorising the supply of electricity by the Council. Section 3 of the order, providing that the order shall not come into force or have effect, notwithstanding the confirmation thereof by Parliament, until such date as the Board of Trade fix a date for the commencement of the order when they are satisfied that the Council has completed the purchase of the undertaking of the Hastings and St. Leonards-on-Sea Electric Light Company, Limited, in accordance with the agreements entered into by the Council with the company, and that as from the commencement of the order the orders previously granted to the company and to the Corporation shall be revoked. The necessary application has been made to the Local Government Board for the sanction to the borrowing of the money required for the purchase of the company's undertaking.

Hull.—There is a proposal to construct a subway, and the gas engineer has sunk a trial bore with a satisfactory result. It is suggested that the Waterworks and Electric Lighting Committees should lay their mains in the subway and take part in the cost (£4,000). The Council is to consider the matter.

Ilfracombe.—A Bill to confirm the Ilfracombe Provisional Order granted by the Board of Trade came before the Examiners of the House of Commons last week.

India.—The erection of the electric light at the Golden Temple, Amritsar, has been completed. There are altogether 16 lights put up round the sacred tank, and one large globe on the tower of Baba Atal. The Sikhs would not allow the interior of the temple to be lighted by electricity, on the ground that it would be contrary to the doctrine expounded by the Guru. The temple authorities have, however, secured two large chandeliers for the inside of the temple, and are waiting to see a change in the views of their co-religionists, especially the Kukas, in the hopes of having them fitted inside the temple later on. The cost of the whole is about Rs.60,000.

Ipswich.—The tenders for the installation of the electric light at the new Workhouse were to have been opened at the meeting of the Board of Guardians on Friday, but the clerk said that he had only received three, and he had heard something mentioned as to there having been a misunderstanding. No tender had come in from either of the local firms. It was decided to defer the consideration of the tenders for a week.

Isle of Wight.—At the last meeting of the Shanklin District Council the members deputed to discuss with the Sandown District Council the question of the lighting of the two districts by electricity, reported having met representatives of Sandown. It was then explained that Messrs. Edmundson were prepared to form a company for the supply of electric light within the districts. The company explained its terms *re* charging, time of purchase by the Corporation, &c. The estimated outlay was stated to be £25,000, including an anticipated 10 miles of mains. A draft agreement had been forwarded, but the matter was not discussed, the clerk being instructed to confer with the solicitor to the Board and a representative of the company.

Islington.—The report of the Electric Lighting Committee shows that during the quarter ending March 31st the Vestry has made a profit, after paying all its liabilities on capital account, of £1,753. The sale of the light is increasing by leaps and bounds. In the corresponding quarter of 1897 the number of units sold, including public lighting, was 132,044, which produced a revenue of £3,213, but in the last quarter the supply had gone up 99 per cent., the total units sold being 263,502, or an increase of 131,458. The revenue was £5,917, or an increase of £2,704. The working expenses in the March quarter of 1897 were £2,035, or nearly equal to 3¾d. per unit. During last quarter the expenses of production were £2,668, or nearly equivalent to 2½d. per unit. Thus the working expense only increased 31 per cent., while the revenue increased by 84 per cent. The net profit in March, 1897, was only £147, and £1,205 gross. Now the gross profit is £3,326 and £1,753 net.

Leith.—On Wednesday last week Bailie Manclark, the convener of the Electric Lighting Committee took out the first shovelfull of earth at the foot of Leith Walk, and the laying of mains was proceeded with immediately.

Leyton.—A Local Government Board inquiry is to be held on 20th inst. *re* the Council's electric lighting extensions loan. The electrical engineer has reported as follows:—Units generated in March, 23,451; units sold, 14,506; maximum current, 390; lamps installed, 828; total lamps installed to March, 6,788·6; total applications to date (April 5th), 126; total customers connected to date (April 5th), 116; less customers disconnected, 4; net total, 112; largest number of lights on at any one moment, 3,900, being about 58·3 per cent. of the total connected. The tender of the General Electric Company for dynamos, for the sum of £647 16s. 6d. has been accepted, instead of that of Messrs. Siemens Bros. & Co., who could not undertake to deliver the dynamos until the expiration of eight instead of three months, as provided by the specification.

Lincoln.—In a few weeks the Corporation will commence to lay electric mains for the supply of electricity, and we understand that an arrangement has been made with the National Telephone Company to lay their underground cables at the same time, the company bearing the cost of the trenches, &c.

London.—The clerk to the St. Giles Board of Works reported at the last meeting that he had, with the surveyor, attended the inquiry held by the Board of Trade into the supply of electricity to the district, and they had been successful in all they had contended for. Mr. Doll: That is, in two years we are to have a competitive supply.

Long Eaton.—The Co-operative Society has asked the District Council for permission to take electric cables along the streets from the old gasworks to their property in Main Street. The subject stands deferred.

Lowestoft.—The Corporation is considering the advisability of providing electric light, and a provisional order has been obtained. One clause would have empowered the authority to supply electrical fittings and fixtures, but to this the Board of Trade objected. At a meeting on Monday, May 10th, the Council decided to press the Board for the retention of this clause, or a modification. It is intended to work the electric light in conjunction with the Horsfall destructor.

Ludlow.—The Town Council last week formally resolved, on the recommendation of the Lighting Committee, to give the £20 prize offered for the award of best electric lighting scheme to Mr. Enwright, of Kensington. The Committee were much disappointed to find that the mill power was not sufficient to drive an electric light plant. Of the 10 schemes received only two exclusively dealt with the water-power, and these in such a way as to interfere with the Waterworks power. They could not entertain a scheme which would interfere with the water supply. Mr. Enwright's scheme proposed to use gas for driving power. The idea was to erect a Dowson's patent gas apparatus to provide its own gas, and to lay down two engines of 54 horse-power, which would be sufficient to provide light for six or seven hours a day for the whole borough. It was proposed to erect the plant in the Cattle Market, with a main feeder to the Butter Cross, from whence the mains would be distributed. The total expenditure for this scheme was £5,000, the estimated annual cost to the Corporation was £650, and the estimated annual revenue £1,300, yielding a profit of £500 or £600 a year. Mr. Enwright also stated he would find a contractor to carry out the work at the figures named.

Luton.—Over three years ago the Council obtained an electric lighting provisional order, and has since obtained an extension of it for one year. An electrical engineer recently submitted a report on a scheme, and a deputation inspected systems in various places. A few days ago the party went to Brighton, and were shown round by Mr. Arthur Wright.

Malvern.—Messrs. C. Santler & Co. are lighting up the Arts and Industries Exhibition at Malvern from May 3rd to 10th at the Assembly Rooms. There are three arc lights of 1,000 H.P. each, and a number of incandescent lights on exhibition stalls of 8 and 16 C.P. each. There is no public electric lighting in Malvern.

Manchester.—At the monthly meeting of the Manchester Corporation on Wednesday last week, Alderman Higginbottom, in moving the adoption of the minutes of the committee, explained the circumstances under which he and the deputy chairman had been appointed to give evidence before the Special Joint Committee of the House of Lords regarding the supply of electrical energy by Corporations and others, and this was a matter which affected that Corporation and other authorities. The Joint Committee was appointed because of a difficulty that had arisen between Lord Morley, chairman of the Lord's Committee, and Sir Courtenay Boyle. The important principle was involved as to whether companies were to be allowed to compete with Corporations and other authorities within their own areas. If this were so, the Manchester Corporation would be placed in a serious position. The Manchester Tramways Company had a Bill before Parliament, and if the principle he had spoken of were granted, the company might have power not only to work the tram lines electrically, but also to compete with the Corporation in the supply of the electric light to consumers. He could not conceive that the Joint Committee would report in opposition to the interests of Corporations. If they did, the Corporation would have to take steps to be heard before Parliament in another matter. He could assure the Council that he, and those co-operating with him, had done their best to defeat a very wrong thing indeed. The estimate of the electricity department in Manchester for the current year amount, on expenditure account, to £7,000, the current for public lighting absorbing £1,500, and lamps and connections £5,500.

Monmouth.—The local papers are full of a report of last week's Council meeting, which lasted for three hours, the greater part of the time being passed in a discussion regarding remote points in the drainage and electric lighting scheme. The matter really seems to refer more to the drainage works than to the electric lighting affairs, there being some disagreement between the consulting engineer and one of the contractors; but wherein the electric lighting scheme is affected is the resignation of the chairman and another member of the Electric Lighting Committee, the former having been actively connected with the combined scheme all along.

Montrose.—The Asylum House Committee has had under consideration the renewal of the electric lighting plant of the main building of the institution. The report of Mr. Young, engineer, Glasgow, had been considered, and, on his suggestion, it was agreed that the type of engine should be the Belliss. After consultation with Mr. Young, it was agreed to accept the offer of Messrs. W. Dickson & Co., Glasgow, to carry out the installation, their offer being in every respect the lowest.

Morecambe.—In connection with the installation of electric light at Morecambe, tenders are invited for supplying a wrought-iron water tank, 5,000 gallons capacity, by Mr. C. F. Parkinson, the engineer. It was expected that the work would be completed for Whitsuntide, but it has been delayed, and will not be finished before the latter part of the season. When the front Promenade is first lighted is is intended to hold a *fête*, which will take the form of a "Battle of Flowers." The District Council some time ago took over the works of the private company.

Newcastle.—At last week's City Council meeting Mr. W. Smith presented the report of the special committee appointed to consider the desirability of the Corporation undertaking the provision of electricity, recommending that the committee be authorised to negotiate as to terms upon which the electric light companies will transfer their undertakings to the Corporation.

Ossett.—The Town Council has resolved to visit and inspect the electric lighting plant and refused estructor in Shoreditch, with a view to ascertaining the practicability of combining the two objects in Ossett.

Perth.—The Board of Trade have issued a provisional order to the Police Commissioners in connection with the electric lighting of the city.

The Police Commission has received a letter from the Mutual Electric Supply Company, Brighton, stating that if the Commissioners were disposed to delegate the powers under their provisional order for electric lighting, they were prepared to offer terms for consideration. The Commissioners have replied that they are not yet in a position to entertain a proposal, but that it would be considered at the proper time.

At the monthly meeting of the Police Commission on Monday, discussion took place regarding an account of £15 15s. tendered by Mr. Thomas Barton, Blackburn, for a report on the electric lighting scheme. The Lord Provost Dewar said Mr. Barton offered to come and give them the benefit of his advice, but it was on the understanding that they were not to be committed to him either for advice or in the appointment of an electrical engineer. The country, his Lordship continued, was swarming with gentlemen of this kind, who were willing to go here, there, and everywhere, to advise those interested in electric installations. They were in the position of gentlemen who had something to sell, and they meant to take the opportunity of selling it. The Corporation paid Mr. Barton's expenses, and it was on the distinct understanding that there would be no other claim that Mr. Barton was allowed to give advice at all. One or two other gentlemen had been employed on the same terms, and it would be a dangerous precedent to admit this claim, even to the extent of five guineas, as was proposed. He objected to paying every gentleman who volunteered his services to the Commission. It was agreed to deny liability.

Peterborough.—The local company which was hoping to undertake the electric lighting of Peterborough in the event of the Local Government Board persisting in its refusal of the application of the Town Council for raising a loan, is, of course, disappointed at the Board's last step in granting powers to the municipality. The Peterborough Electric Lighting and Power Company seems to think that the Board will neither revoke its order nor grant the application, yet it is considered that the Board would not allow two orders to be worked, as the area is not large enough to justify that step.

Plymouth.—At the meeting of the Town Council on Monday there was an animated debate previous to agreeing to the large increase in the rates, *i.e.*, 11d. in the £. Naturally the electric lighting and traction scheme came in for some criticism. Mr. Bellamy, one of Plymouth's foremost men, and who is connected with the gas company, agreed that the town was badly lighted, and that something should be done. But with gas at 1s. 9d. the 1,000—the cheapest in England—that was, he considered, not a town to go in for a luxury like electric light. He believed there would be a loss on the electric light and work generally of £1,500 a year.

Poplar.—The following took place at a recent meeting of the District Board of Works, and is reported in a Whitechapel paper:—The County of London Brush Provincial and Electric Light Company wrote asking for the name of the member who accused the company of "touting" for the company, and saying that unless it were given proceedings in another quarter would be taken. Mr. Marks: Who was the letter addressed to? The clerk replied that the first letter was addressed to himself, and it appeared to be a personal application to him, because the letter said, "I shall be glad to hear from you." Mr. Marks: Then the letter is a private one, and we have nothing to do with it. The clerk explained that he had placed the letters before a special committee, who would have nothing to do with the matter. Mr. J. R. Smith: I shall move that the communications be laid on the table. Mr. Purdy seconded the motion, which was unanimously agreed to.

Rathmines.—Mr. Robert Hammond is to furnish a supplemental report on his proposed scheme for lighting the town electrically. The secretary of the Electric Light Committee has reported having taken legal advice as to the extent of the obligation thrown on the Tramway Company by the 15th section of the Electric Power Act, 1897, to light the road, and Mr. Fitzgerald is of opinion that that section required the company, where pillars are erected in the centre of the road, to light the whole width of the road to the satisfaction of the local authority.

Sheffield.—There is a proposal before the City Council to appoint a Special Committee to take into consideration the desirability or otherwise of proceeding further with the separate electric power station, seeing now that the Corporation are owners of the present electric station, where there is sufficient room to put all that is required for the tramways for a considerable time to come, and, in the meantime, to make full investigation into how far the waste heat of all the destructors and water-power might be used in the future for generating electricity, and report.

The Parliamentary Committee has expressed its approval of the steps taken by the town clerk in conjunction with the representatives of other towns in the district to oppose the Bill of the General Power

Distributing Company, and also with reference to the Joint Committee of Inquiry which has just been considering electrical matters in London.

Shoreditch.—On 5th inst. the Electric Lighting Committee issued its first report, showing the results of the first nine months' working. There is stated to be a profit of £2,063 0s. 4d.

St. Pancras.—At the meeting on Wednesday the Vestry resolved to reduce the charge for current for public street lighting from 5d. to 4d. per unit, the alteration to come into force on July 1st. It was also decided, commencing on the same date, to reduce the charge to private consumers to 6d. per unit for the first 1½ hours' daily consumption, and to 3d. per unit for all current used afterwards. The Vestry sanctioned an expenditure of £790 for additional condensing plant for the King's Road station. The Elieson Lamina Accumulator Company, 4, Greenland Place, N.W., has consented to lend the Vestry a motor dust van on trial, provided that the local authority would supply the current for charging purposes free of expense. The Dust Committee has accepted the offer.

Swinton.—Last week a meeting of ratepayers and owners resolved to oppose the General Power Distributing Company's scheme.

Teignmouth.—The Gas Committee of the District Council recommends that information be obtained showing the probable cost of a provisional order for lighting the town by electricity.

West Hartlepool.—Tenders are shortly to be invited for the erection of the lighting station. The Sub-committee has submitted its report to the Corporation on dust destructors. After visiting Bradford, Oldham, Shoreditch, Leyton and St. Luke's (London), it is recommended that a six-cell destructor be obtained for West Hartlepool at a cost of about £5,000 or £6,000.

Westgate-on-Sea.—A Board of Trade inquiry will be held by Major Cardew to-day (Friday) in the matter of the Isle of Thanet District Council's application for a provisional order.

Wick.—The Harbour Trust had recently under discussion a proposal to light the harbour with electricity, the motive power to be derived from an overflow stream which falls into the outer basin. Owing to shortness of funds the proposal is to be held in abeyance in the meantime.

Wigan.—Circulars were recently issued to ratepayers *re* electric lighting; 69 were in favour of an installation being laid down, and 61 undertook to use the current. 85 were not in favour of an installation, and did not undertake to use the current. 29 were in favour of an installation, but would not undertake to use the current, and 69 gave a provisional undertaking. The Gas and Electric Lighting Committee recommended the Town Council to appoint a sub-committee to make inquiries into the subject of electricity generally, and for that purpose to visit six towns where public electric lighting has been established. This resolution was the subject of a discussion at the monthly meeting of the Council on Wednesday last week. Mr. Laycock said he desired to take exception to the resolution which was passed at the meeting of the Gas and Electric Lighting Committee the previous day. He failed to see the advisability of appointing another Sub-committee. They all remembered that in March of 1894 a Sub-committee, consisting of 14 members, was appointed. They had practically a roving commission given to them to make inquiries all over the country, and he was inclined to think they even went out of the country to get information upon that matter. At the end they issued a report, and they advertised and succeeded in getting tenders for the laying down of plant, but although they had got much information, and spent, he believed he was right in saying hundreds of pounds of ratepayers' money in getting that information, yet they did not recommend whether the high or low tension should be adopted in Wigan. Even in asking for tenders they left it for the electrical engineers to say whether they would recommend high or low tension. He thought that was purely an engineering and a technical matter, and he thought the better course to adopt would be to get the opinion of an expert before they appointed another committee. An expert would recommend a proper system, and give them places where it had been adopted, and the Committee would be able to recommend the Council to adopt a particular course. To give the Committee power to roam about as the other Committee did would be a waste of money. Mr. Ashton said that the minute was put on the book to get the feeling of the Council as to whether they were in favour of the electric light or not. Personally, he thought it ought to go forward in Wigan. After further discussion the minute was withdrawn.

Wimbledon.—At last week's District Council meeting Mr. A. H. Preece submitted his report and plans on the question of the combination of the refuse destructor in the boiler house of the electric light works. The total estimated expense was £4,650. Mr. Preece was extremely anxious that the interest and sinking fund of the destructor should be kept distinct from the electric lighting accounts. The electric lighting undertaking should also be paid at least 1s. per ton if it was to undertake the working of the destructor. The Council resolved to apply to the Local Government Board for sanction to a loan of £5,000. A number of tenders were recently obtained by the surveyor from certain firms for the electric wiring of the depôt buildings in Queen's Road, but the Council has resolved to return these tenders, and advertise generally for estimates. The cost is about £150.

Wolverhampton.—At Monday's meeting of the Town Council the Lighting Committee presented a report, in which they proposed to make a reduction in the average number of hours per day during which the maximum demand is to be used from 2 hours to 1½ hours. The Committee recommended "That as and from July 1st, 1898, the price for energy for lighting purposes be fixed at 6d. per unit, on a maximum demand of an average of 1½ hours per day, and 3d. per unit for all energy consumed in excess." The Council adopted the resolution.

Worcester.—Mr. Ruthven Murray, the borough electrical engineer, has, in accordance with the instructions of the Council, issued his report upon the working of the generating station for the past year, dealing with the various matters in the abstract of accounts issued by the committee some months ago. He calculates, says a local paper, the additional cost for coal, by reason of extra cartage to the works, at £127 on the 1,702 tons consumed in the 12 months, and he points out that this represents 6 per cent. on £2,100. He estimates the revenue derived from water-power at £1,880. Dealing with the question of the charge to be made to consumers, he says: "The lowness of the average price obtained is not proof that we are supplying under cost, as has been urged, since, whether a profit or loss is made depends entirely on the length of time the supply is used or the number of units consumed per maximum lamp demanded. The units sold at 6d. cost 8d. and upwards, whilst those sold at 2½d. cost under ¾d. I am strongly in favour of an alteration in price, but such alteration must be to charge the short hour user somewhere nearer the cost of the supply, so that the loss incurred on such shall not be borne by the profitable consumer, as is now the case." He proceeds, also, to explain how so great a loss as 25 per cent. of the current generated is occasioned, viz., by the performance of work in the system, either by magnetising iron in transformers or meters so as to increase the sensitiveness in registering a very small proportion of their full load current, or in overcoming the resistance to the transmission of energy in the mains or other conductors. The lost power generated by water represents 55·26 and by steam 44·74. Of the total power generated during 1897, water-power represented 46·60 against steam 53·40.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—It will be remembered that the Tramway Company has informed the Corporation that it cannot establish electric traction upon its lines unless its lease is extended. Last week there was a proposal before the Corporation to make the Law and Electric Committees into a Special Committee with a view to inquiring into the whole question, but after a lengthy discussion the matter fell through, the meeting being counted out before a vote was taken.

Birkenhead.—The report of the Special Tramways Committee, which we gave briefly last week, was adopted by the Town Council on 4th inst., without binding itself to the detail of the routes suggested. In the discussion upon the report there was some opposition, and it was urged that having regard to the contemplated outlay, namely £200,000, the matter should be dealt with by a full meeting of the Council, whereas only about half the members were present at the meeting. However, the report was adopted by a large majority.

Birmingham.—The old tramway controversy is agitating the minds of the City Councillors, who, it will be remembered, blocked the way for enterprise by declining to allow the Tramway Company to use the overhead trolley system. Mr. Ross's statement, which appeared in our "City Notes" last week, to the effect that the company at one stage of the negotiations received permission to use the trolley system, is denied by members of the Council, and the Town Clerk is communicating with Mr. Ross on the subject.

Dublin.—The Clontarf and Hill of Howth Tramroad Bill was before a Select Committee of the House of Lords last week. The tramway will run along the foreshore of Dublin Bay and terminate at Howth. It will form a connection with the tramways of the Dublin United Tramways Company, which are worked by electric power. The overhead electric trolley system is proposed. Mr. Fraser, M.I.C.E., engineer to the scheme, gave evidence.

The Dublin Southern District Tramways Bill in relation to the speed allowed on their lines was before a Select Committee of the House of Commons last week.

The Drumcondra Commissioners have decided that the Dublin United Tramways Company be charged wayleave for being allowed permission to run electric trams through the township, first payment to commence at the end of 10 years from the obtaining the order from the Privy Council, and the amount to be paid to be then arranged by arbitration between the Town Commissioners and the company, the line of rails to be placed on the centre of the road, and the extension to be completed within five years.

The Kingstown Commissioners are endeavouring to induce the Dublin United Tramways Company to undo some of the damage to the township, which the Southern Districts Company, with the full assent of the same Commissioners, inflicted. The company, according to *Freeman's Journal*, is proving amenable, and in its own interests. For if the double lined tramway has added enormously to the difficulties of business men in the main thoroughfare of Kingstown, the delays of the cars in getting through have detracted very seriously from the attractions of the tramway service.

Dudley.—At last week's Council meeting the mayor, moving the adoption of the report of the Railway, Tramway, and Electric Lighting Committee, remarked that in the matter of the proposed tramway to Cradley Heath they wished to work harmoniously with the Rowley Regis District Council. If the Rowley authority would not construct a line in their district and would give Dudley the power the latter would do it. The Rowley people, however, had decided to do it themselves. A report is being drawn up of the deputation's visit to the Worcester Electricity Works.

Dudley-Stourbridge.—Last week an active start was made with the alteration of the permanent way to permit of the introduction of electric traction. The rolling stock is being made as quickly as possible, so as to effect an early completion of the undertaking.

Dundee.—The Coporation Tramway Bill under which power is sought to work the lines in Dundee and district, was before a Select Committee of the House of Lords last week.

Ealing.—Various electric tramway matters were under consideration at last week's District Council meeting. There was a letter from the Simplex Electric Traction (Conduit) Company, setting out the advantages of the company's system of electric traction for tramways, and inviting the Council to see it in operation at Prescott, and also a communication from another firm anxious to acquaint the Council with the merits of its electric traction apparatus. The scheme of the London United Tramways Company was discussed, and the voting was 7 in favour of the following resolution and 8 against:—"That this Council withdraw its opposition to the London United Tramways Bill, subject to terms and conditions being arranged, and that Mr. Clifton Robinson be requested to meet the Council in committee with the view to the adjustment of such terms and conditions." The motion was accordingly lost. One member and the chairman did not vote.

Electric Power Schemes.—The Notts and Midland Traders' Association has passed a resolution expressing the opinion that it is desirable to encourage the introduction of electrical power into the towns and villages of Nottinghamshire, Derbyshire, and district, as it would prove of the utmost practical utility in aiding agriculture, village trades, and general manufactory purposes. This was in connection with the General Power Distributing Company's scheme.

Glasgow.—The Tramway Committee recommended, and it has been approved, that it be remitted to the sub-committee on the Springburn route to make arrangements to have poles, &c., put up on the High Street line, at present being constructed, and which had unusually steep gradients, so that it might be worked with electric power in connection with the Springburn line.

Grimsby.—The tramway track is out of repair in some places, and the company is delaying remedying the defects in view of the probable adoption of electric traction very shortly. The Highways Committee, however, has requested that the lines be put into repair at once.

Hastings.—The scheme of the Hastings, Bexhill, and District Light Railways (Electric) Company is to be again considered by the Town Council. The Council's own scheme was not passed by the necessary two-thirds majority, hence the re-opening of the negotiations with the company. Mr. Murphy will attend a special meeting of the Council to confer *re* the company's proposals.

Italy.—It is reported that Messrs. Siemens & Halske, of Berlin, have submitted to the municipal authorities of Alessandra and Valenza a proposal to construct an electric railway between the two towns, a distance of about 40 kilometres. It is proposed to utilise the water-power of the river Po in the generation of the necessary electrical energy.

Johnstone.—The British Electric Traction Company have lodged an application with the Town Council soliciting their approval of their scheme for constructing a tramway in the burgh connecting with Paisley. The application raised a lively discussion at the monthly Council meeting. The Council wants further information of the scheme.

Kidderminster-Stourport.—Successful trial runs were made over this electric line on Tuesday and Thursday last week. Tuesday's trial was merely to test the accuracy of the gauge, but on Thursday electric power was used. The official inspection is fixed for Monday next, May 16th.

Leeds.—The question of providing electric cars on the Wortley route was considered at a meeting of the Leeds Highway Sub-committee on 9th inst. A deputation presented a petition signed by about 400 ratepayers, entering an emphatic protest against the decision to extend the electric system of traction to the four routes mentioned, to the exclusion of Armley and Wortley. The objection which the committee have to deal with on the Wortley route is that the cars would have to be turned in Boar Lane, a proceeding which would cause considerable inconvenience to the traffic in one of the most crowded thoroughfares of the city. Some means of overcoming this difficulty, it was said, must be found before the electric system can be extended to Armley and Wortley. The committee, however, agreed that it was desirable that the system should be extended to the Wortley route at an early date, and will probably deal with the question as soon as the work upon which they are entering is completed. Dr. Hopkinson was again appointed consulting electrician in connection with the extensions, and was instructed to prepare plans and specifications for the four routes decided upon, and to submit them to the committee when ready.

Liverpool.—It seems that Sir Arthur B. Forwood has actually severed his connection, not only with the Tramways Committee but with the City Council. The circumstances which led to this were briefly stated in our last issue.

London to Oxford.—The *Financial News* says:—"The Light Railways Act possesses possibilities to which commercial men are waking up. We are told of a dream of England one vast network of tramways. It will probably remain a dream; for the world has not leisure to travel slowly nowadays. But there is talk of a scheme more practicable—the establishment of a road tramway from London to Oxford. It is not hoped to secure much through traffic, but to link the towns and villages together in one whole, and thus to develop local traffic. We presume that electric traction will be aimed at, and that the overhead wire is deemed the best system. That gives a rather appalling idea of what rural England may become in time."

Manchester.—The recent conference which took place last week between the Manchester Corporation and representatives of the local authorities interested in the tramway service failed to bring about a satisfactory arrangement in view of the expiration of the Carriage Company's lease, the Tramways Committee of the City Council have, according to the *Manchester Guardian*, reconsidered the subject, and now submit the following scheme, subject to Parliamentary sanction:—1. The several authorities outside the city shall, at their own cost, acquire and place the lines in their respective districts in a condition suitable for electric traction. 2. The several local authorities shall, either by themselves or by arrangement with the Electricity Committee of the Corporation or other local authority, provide electric energy and necessary equipment for the working of the tramways in their districts on the same system and at the same voltage as proposed to be adopted in Manchester. 3. Each authority shall fix the fare in its own district, and the same shall be placed to the credit of such authority. 4. Each authority shall be debited with the following and such other charges, not included under these headings, as may be incurred in the working and management of the tramways in the districts of such authority, all such charges to be ascertained on the car mileage principle:—(*a*) Traffic expenses; (*b*) management expenses; (*c*) repairs and maintenance of car sheds, workshops, &c.; (*d*) repairs, maintenance, and renewals of rolling stock; (*e*) interest on capital expended on rolling stock, car sheds, workshops, &c.; (*f*) sinking fund in respect of same; (*g*) depreciation in respect of same; (*h*) electric energy in cases where the Electricity Committee of Manchester Corporation supply the same; (*i*) a charge of 5 per cent. on the total working expenses incurred by the Corporation under the above-mentioned items, exclusive of electric energy. 5. The net receipts in each district after deductions as above indicated to be handed over to the local authority. 6. The repair and maintenance of the permanent way in each district shall be undertaken by the local authority at their own cost. 7. This arrangement to be subject to revision at the end of three years' working. These terms are receiving consideration from the local authorities.

A conference took place in Manchester on Tuesday between the Manchester Corporation and representatives of local authorities interested *re* the suggestions made by the Manchester Tramways Committee. After discussing the matter in all its bearings, the various representatives failed to arrive at an agreement, and it therefore remains in abeyance. The Manchester Corporation, have, however, intimated their intention not to renew the lease with the Manchester Carriage and Tramways Company unless horse traction is abolished.

Middlesbrough-Stockton.—Work is stated to be so far advanced on the electric tramways that a trial trip is to be made in a day or two, and the lines may be opened by Whitsun week. The cables are laid and there are at the depôt 8 or 9 cars each to carry 60 passengers. The engines are being put in position in the power house. The car shed is almost completed and the battery room is progressing. A model truck in wood has been tried over a part of the track.

Norwich.—The promoters of the Norwich Electric Tramway Bill came before the Examiners of the House of Commons the other day for proof of compliance with the standing orders in regard to certain additions which it is proposed to make to the Bill as originally introduced. The necessary notices had not been given in time, so the Examiner decided that the Standing Orders had not been complied with. The matter is accordingly referred to the Standing Orders Committee.

Queenborough.—The promoters of the Sheppey Light Railway which is to be constructed at a cost of £52,000, in order to bring Sheerness into touch with Minster, have received notification that the Light Railway Commissioners will recommend the Board of Trade to issue an order empowering the construction of the proposed line from Queenborough to Leysdown.

Rochester and Chatham.—Although the inhabitants of Rochester and Chatham are naturally disappointed with the decision of the Light Railway Commissioners as to the proposal to introduce a system throughout the district of electric trams, still it is consoling to know that, after all, a very useful part of the scheme will yet most likely be carried out, as the whole scheme has not yet been set on one side by the Commissioners.

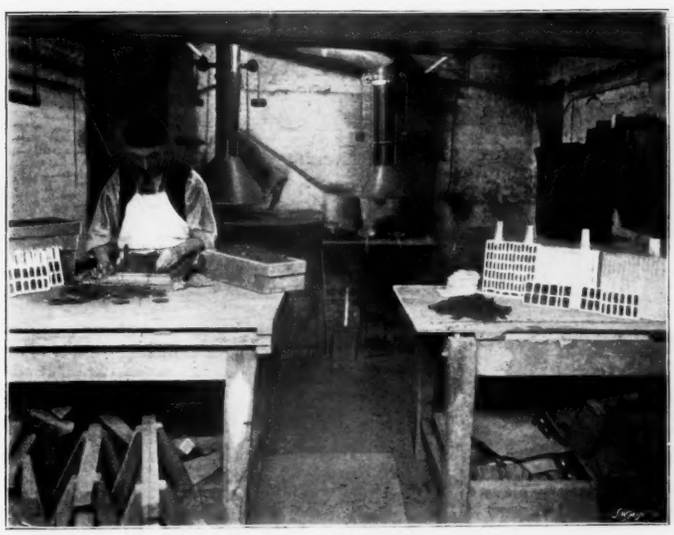
(*Continued on page* 661.)

THE MAKING OF LITHANODE ACCUMULATORS.

It will probably form an interesting addition to the series of articles on the manufacture of accumulators if we give some account of the process of making Lithanode cells. The company which is now associated with this type of battery is the Lithanode Electric Storage Company, Limited, which was formed some two years ago to acquire and work the rights and patents appertaining to the manufacture of lithanode accumulators. It is hardly necessary to say that the original application of lithanode for secondary battery purposes was due to Mr. Desmond FitzGerald, and his patents, as well as those of Mr. J. T. Niblett, are now vested in the Lithanode Electric Storage Company. The following description of the construction of this cell is taken from Mr. Niblett's recent paper :—

Making Lithanode Paste.

"Lithanode is not compressed peroxide of lead, as is sometimes supposed; for, however strongly this lead peroxide may be compressed, the resulting mass will disintegrate when immersed in a liquid electrolyte. It is produced from litharge made into a pasty mass with a solution of sulphate of ammonia, which causes the material to 'set,' so that it will no longer disintegrate when placed in a fluid. The 'forming,' according to the original idea, was performed in a bath of sulphate of magnesia. In ordinary practice the elements are made up of a number of small slabs of lithanode, whose outer edges are V-shaped. These slabs or pellets are arranged in a casting mould of any suitable dimensions, and are placed at such a distance apart and from the edges of the casting frame as to allow of sufficient space for the requisite quantity of metal to run in and impart adequate mechanical strength to the completed element. After the pellets have been arranged in this manner, an alloy of lead and antimony is run into the interstices, and thus a complete plate is formed.



Casting Frames.

"Before being cast up the positive pellets are converted into peroxide of lead in a forming bath; those for the negative plate are simply dried and cast up direct, the lithanode in the latter case being reduced to a condition of spongy lead by the ordinary electrolytic method.

"Where lightness is a desideratum, as in the case of a traction cell, the pellets in the positive plates are made larger, while the negative plate is constructed of lead gauze, having its outer edge strengthened by a rim of lead. The gauze is filled in with the prepared litharge which entangles itself in the thin lead wire, and thus produces a plate of great lightness, and one little liable to fall to pieces.

"Lithanode may be obtained in varying degrees of porosity. For high discharges it is made of a highly porous nature, the porosity being produced by incorporating in the material crystals of some salt, which is practically inert, and which is dissolved out during the forming operation.

"The rate of discharge obtainable from lithanode batteries varies between very wide limits, and is regulated by the character of the lithanode, whether made hard, medium, or soft. The ordinary working rate of discharge is $\frac{1}{14}$th of an ampere per square inch of lithanode plate, but owing to recent improvements very much higher rates of discharge can be obtained. The electrical capacity of lithanode, when discharged at the above rate, is almost exactly 1 ampere-hour per ounce, so that in a lithanode element weighing 1 lb. a current capacity of 16 ampere-hours is obtained. In practice, however, this high capacity is never reached."

It is generally thought that the chief direction in which lithanode has been applied is in small and portable forms of batteries; while, of course, a great measure of success has been achieved by the company in the manufacture of the smaller class of cell, this is by no means the limit of the company's operations, because lithanode cells have been made for purposes demanding heavy outputs. An instance of the company's work in the way of large batteries is one of 240 cells, which was supplied some time ago for Vera Cruz, this being probably the first storage battery ever erected in Mexico. This battery is employed in the town lighting of Vera Cruz, and reliance is placed on it both for lighting and power purposes.

We have already alluded to the success achieved in exploiting lithanode cells for small work. X ray operation for surgical and hospital work has called for a reliable and compact secondary battery, and the Lithanode Company seems to have created a great reputation in this direction, and both in this country and on the Continent great use has

been made of the lithanode cell for this class of work. Among medical men the productions of this company are held in great repute, and their accumulators are being used not only in cautery work but also for driving small motors such as are used in dentistry and surgical work.

We have quite recently had an opportunity of witnessing some of the operations necessary in making lithanode batteries at the works of the company, situate at Mann Street, Bermondsey, where a large factory has been completely remodelled for the manufacture of accumulators.

The basement of the building is given up to the pasting of plates, the casting of the grids or frames, the forming of the plates; and here is also the drying rooms. One of the series of illustrations which are here reproduced, shows the operation of making up litharge into a paste. The operator takes the dry powdered litharge and reduces it to the required pasty condition, by means of sulphate of ammonia; the next operation is to shape the material into

Fitters' Shop.

Lead Burning.

slabs or pellets as required, which are then taken to the drying rooms, where they remain till sufficiently dry and hard for treatment. Following the course of the pellets a little further, we find that those destined for the positive plates are placed in a forming bath to be converted into peroxide of lead, lithanode, of course, forming the basis of both positive and negative plates, but the pellets for the negative plates are dried and cast up direct. In the casting operation, of which an illustration is given, the operator arranges the pellets on the lower half of a mould, and after closing it pours molten metal round, the pellets, as we have before observed, being placed at a slight distance apart in order to permit the metal setting round.

The process of forming employed needs no special remark, it being the usual electrical one. In order, however, that the forming action be continuous without running plant at night, a battery of accumulators is employed which continues the formation process after the machinery has been shut down. The ground floor is devoted mainly to lead burning and fitting the plates together.

One of the illustrations shows the process of burning a set of plates together. The next floor is set apart as a fitters' shop, and here are made all the fittings necessary for the portable lamps. Then there are the carpenters' shop, the theatrical department of which we shall have more to say subsequently, and what is termed the sealing-in shop. When the batteries are assembled, they are taken to the sealing-in shop, and there sealed in and filled up ready for charging purposes.

Electrical power is obtained on the premises from a Crompton dynamo, which is driven by a horizontal steam engine, and in addition there is the storage battery, to which allusion has been made.

The following information concerning one of the lithanode cells has been used before, but it may be interesting to reproduce it here:—

Data of Complete 30 Ampere-hour Lithanode Batteries, including Wood Cases.

No. of cells.	Outside dimensions of battery.			Open E.M.F. of battery.	Approximate gross weight of battery.
	Length.	Width.	Height.		
	Inches.	Inches.	Inches.	Volts.	Lbs.
1	3·75	7·00	6·37	2	8¼
2	5·12	7·00	6·37	4	16
3	7·27	7·37	7·00	6	22¾
4	9·50	7·37	7·00	8	29
5	11·60	7·37	7·00	10	36
6	13·75	7·37	7·00	12	43
7	15·78	7·37	7·00	14	50
8	18·00	7·37	7·00	16	56¾
9	20·12	7·37	7·00	18	63½
10	22·24	7·37	7·00	20	70¾
11	24·36	7·37	7·00	22	77¾
12	26·50	7·37	7·00	24	84½

Detailed Particulars of Cell.

Vulcanite cell containing { 6·25 inches long. 2·12 „ wide. 5·25 „ high. weight, 10 ozs.

Positive element ...	Two plates in each cell,	5·9 inches long.
		3·9 „ wide.
		0·25 inch thick.
		weight, 1 lb. 1½ ozs.
Negative elements ...	Three plates in each cell,	5·9 inches long.
		3·9 „ wide.
		0·13 inch thick.
		weight, 11½ ozs.

Weight of connectors, 3 ozs.
Weight of cover, vent plug, sealing, and separators, 2 ozs.
Quantity of electrolyte, 15·5 fluid ozs.
Gross weight of complete cell, 6 lbs. 7 ozs.
Normal charging rate, 3 amperes.
Normal discharging rate, 3 to 4 amperes.
Maximum safe discharging rate, 9 to 12 amperes.
Approximate internal resistance, 0·015 ohm.

In adapting electric lighting to the many and varied requirements of theatrical work, the Lithanode Company have had unique experience, not only in supplying accumulators, but in devising special theatrical effects. We have before alluded in these columns to the different theatrical productions with which this company and its predecessors were associated. To instance the wide field covered in this direction, we might mention that during the last Pantomime season the Lithanode Company, in addition to provincial work, were associated with no less than seven in London, among them being those at Drury Lane, Brittania, Hoxton, and Standard Theatres. Of the effects created at Drury Lane and the Brittanis, we can give personal testimony, and it is no exaggeration to say that the electrical portion of each entertainment was probably the most striking and attractive feature.

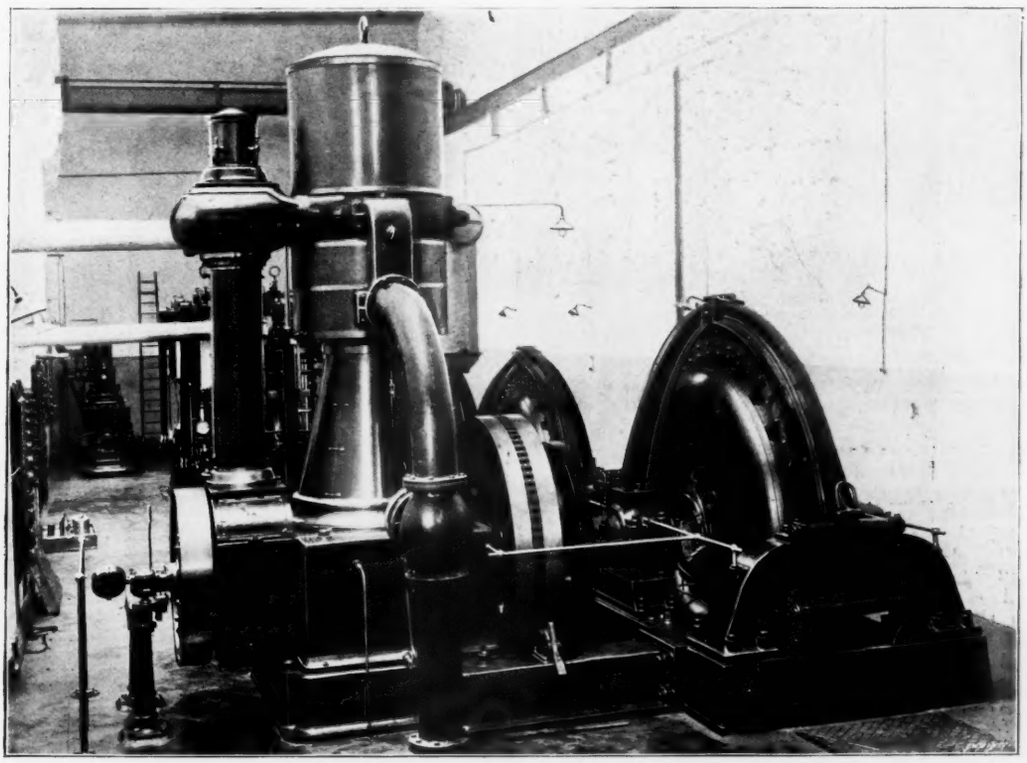
EXTENSION OF THE MALTA LIGHTING SYSTEM.

With a view to extending the electric light in Malta, a 200 kw. plant consisting of a Mordey alternator and Universal single-crank engine has recently been installed by the Brush Electrical Engineering Company. The illustration shows the plant in position. The installing of this unit raises the capacity of the station to 575 kw., disposed as follows:—one 200-kw., three 100-kw., one 50-kw., and one 25-kw. A 200-H.P. boiler of the Babcock-Wilcox type has also been erected, making a total of four boilers, all of the same capacity.

The station, which has been already described in the Review, has been running a little over 16 months, and started from the first with a paying load.

The streets of five towns, including the capital Valetta, are lighted with incandescent lamps of 32 C.P. About 65 arcs of the B.V. type are used for lighting the Grand Harbour and some of the principal thoroughfares in Valetta. These lamps have their own transformers, lowering the voltage from 2,000 to 35. The lighting on this system has given every satisfaction. The above represents about 150 kw. of load for street lighting, which is practically maintained the whole night through.

Beyond this, nearly the whole of the War Department buildings and barracks of these towns are connected on to the mains, being equivalent to about 2,500 8-C.P. lamps.



The Extension at Malta.

These lamps are alight practically the whole evening, till 10.15 p.m., when they come off simultaneously. There have been numerous applications for private consumption, and, now that the new plant is ready, they will be considered, all wiring being carried out by the Maltese Government.

A further extension, to a town called Sliema, will be carried out this year, about four miles away. The streets here will be lighted with incandescent lamps, with a few arcs along the sea front. Several of the forts and barracks at this place will no doubt be installed with the electric light. The price charged for current for lighting is 6d. per unit.

BASTIAN'S ELECTROLYTIC METER.

Mr. C. O. Bastian is probably, in the minds of many, mostly associated with the penny-in-the-slot meter; but he has lately completed arrangements with the Penny-in-the-Slot Electric Supply Syndicate, Limited, for the manufacture of an electro-

lytic meter, which has some very distinguishing features. The whole subject of electrolytic meters will doubtless be discussed after Mr. Gibbings's paper, which deals in a great measure with Mr. Bastian's meter.

The question of meters that will register small currents with accuracy is an important one to electric lighting systems, but the matter of initial cost of a meter is equally important. It is obvious, however, that there is little prospect of either the motor or clock type of meter being produced at a much lower cost than at present obtains, and it would seem that one must look in other directions to find a cheap means of registering small currents.

Not long ago we should imagine that the suggestion of using an electrolytic meter to surmount these difficulties would have been regarded only in the light of a last resource, but the Bastian meter is claimed to be sucha distinct advance on all previous electrolytic meters, that there is probably little reason to doubt that it will meet many of the requirements of both central station engineer and consumer.

Mr. Bastian has designed something new in electrolytic meters, which is not only said to be an accurate instrument for measuring small currents, but one which will probably cost half that of the ordinary meters on the market. The most notable electrolytic meter that has been used on supply circuits is that of Edison, the principle of which was that the current passing through a solution deposited metal at a certain definite rate, but the trouble that arose in weighing the plates and figuring out the current used, soon rendered it unsuitable for extensive systems. The direction in which the Bastian meter constitutes a departure from other electrolytic instruments may be obtained from the following details :—

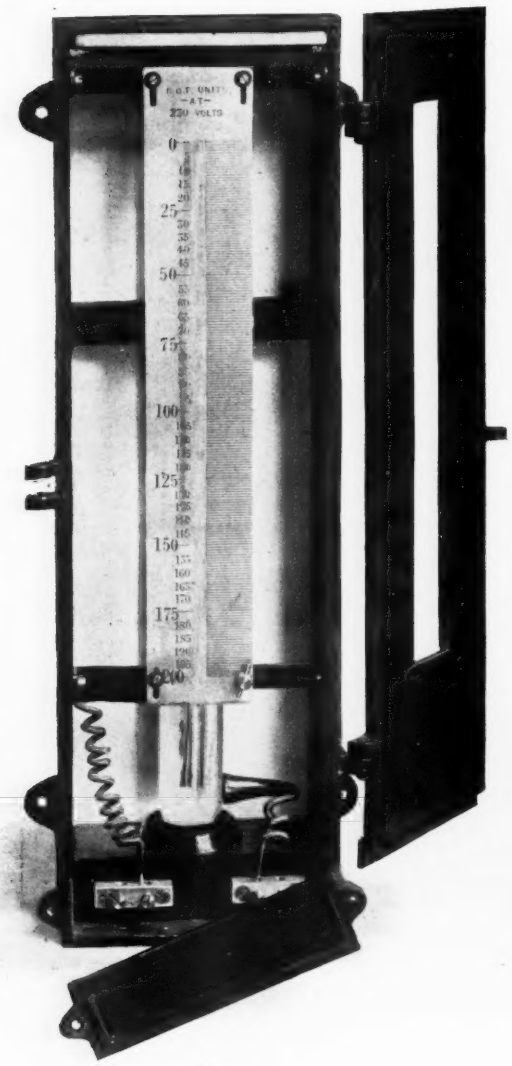
The main feature of the instrument is the registration of an electric current by means of electrolysis. The passage of an electric current through a dilute solution of sulphuric acid decomposes the liquid, and the difference in level is a measure of the current that has passed through.

The apparatus consists of a glass tube, at the bottom of which platinum foil electrodes are placed. The lower end of the tube is sealed, the top being open for the purposes of refilling with water and permitting the escape of the gases. In order to prevent ordinary atmospheric evaporation, a thin film of oil is poured on the top of the liquid.

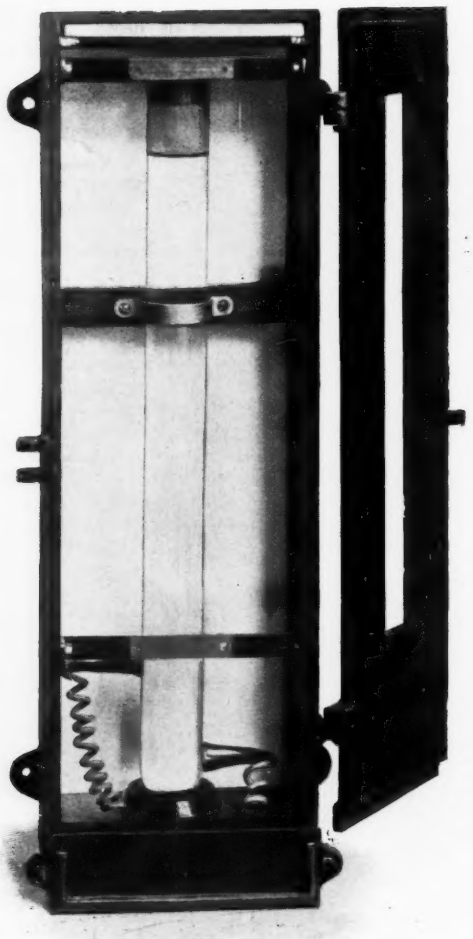
The liquid is composed chiefly of water, rendered non-freezing to within 24° F. below the freezing point of ordinary water by the addition of sulphuric acid, upon which, however, the electric current has no appreciable effect.

It will be seen from the illustrations that the terminals of the electrolytic apparatus are in permanent connection to two other main terminals, which are mounted on a porcelain or ebonite block at the base of the meter. The whole apparatus is placed in a cast-iron case, which is fitted with a hinged door and a terminal door, which are provided with sealing arrangements.

The reading scale, which is marked directly in B.T. units, is placed in front of the tube, and is made of zinc or aluminium. It is so arranged that it can be adjusted to the extent of three-eighths of an inch up or down through the agency of an adjusting nut and thread at the lower end. This



Complete Meter.



Meter with Scale Removed.

adjustment is provided in order to give an accurate zero when the tube is refilled with the electrolyte; it also precludes the necessity of extreme care when refilling.

The action of the meter decomposes the water, consequently, water only need be used when refilling the meter, for which purpose a very convenient form of funnel is provided by the makers. The necessity for refilling even the smallest meters does not arise until 200 B.T. units have been consumed.

It is interesting to examine the method followed in calibrating the instrument. As such a small amount of water is decomposed during the passage of 1 B.T. unit, it follows that a slight miscalculation as regards the bore of the glass tube might lead to a serious error, were the bore of the tube (as measured by calipers) taken as the sole basis for calibration. The actual method adopted admits of no such chance of error creeping in, and, moreover, requires no special calculation for individual tubes.

The makers of the instruments have calculated the quantity of water in cubic centimetres that is decomposed by the passage of 25 B.T. units at the usual pressures from 100 volts upwards, and knowing this, they proceed to calibrate the tube as follows:—The first operation is to fix the tube and blank scale into the meter case, and then fill the tube with water up to the bottom of the scale, which is arranged to be well over the top of the electrodes. This water level is marked on the scale, and then a quantity of water is poured in which will be decomposed by 25 B.T. units at the voltage of the circuit on which the meter is to be used. This second level is marked on the scale, and a second quantity of water representing another 25 units is poured in, and so on until the scale is marked right up to the top. Each of these divisions is then sub-divided into 25 equal parts, so that each division on the scale may represent a B.T. unit.

In this way, any error that might occur through a slight irregularity in the bore of the tube is prevented, and, moreover, it entirely does away with the necessity of using electric current during calibration.

The above method has been tested, and, we are informed, has proved absolutely accurate in practice.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 656.)

Salford.—The Salford Highways Committee deem it essential that a clause be inserted in the new lease of the tramways to the Manchester Carriage Company enabling the Corporation to re-lay the tramways for electrical traction during the renewed term of three years on equitable terms. The Electric Light Special Sub-committee appointed to visit certain places to inquire into systems for the supply of current for lighting and electrical traction have also made their report. They have visited London, Leeds, Brighton, and Dover, and inspected the workings of various electrical stations, and had the advantage of observing the practical working of the plants with a view to the adoption of the best system for the proposed working of the tramcars by the Corporation. The Sub-committee make the following recommendations:—"(1) That the generating plant should be erected at one station with the employment of accumulator sub-stations, the latter being a satisfactory method of utilising the plant during the hours when it would be otherwise idle. (2) That, in view of the prospective great demand for current, the engines and dynamos at the new station should be of large dimensions to secure economy in capital and working expenses, as the current generated at one station would be sufficient for both purposes. (3) That what is known as the feeder system of supply should be adopted in connection with the proposed tramlines, so as to separate the same in small sections to receive such supply. (4) That in the matter of re-arranging the proposed tramlines for the borough it would be desirable that the rails should not be less than 120 lbs. in weight per yard, and the width of the tread not less than 2 inches, and that the distance between the trolley posts to be erected should not be more than 40 yards. (5) That the method of jointing the tramlines adopted at Dover should be employed in Salford, so as to avoid the jolting in passing over the jointed portions of the lines." The sub-committee have not entered into the question of the cost which will be incurred in so extensive an undertaking, which will, of course, be done when the plans are more matured. The details of the ground plan of the new generating station proposed to be erected in Strawberry Road was explained to the officials of the stations visited, and they expressed approval of the system proposed to be adopted.

Sheffield.—Mr. A. Llewellyn Fell, the Corporation electrical engineer, and Mr. L. S. Marsh, Corporation water engineer, have, according to the *Sheffield Independent*, presented to the Tramways Committee of the City Council reports as to the possibility of obtaining water-power from the reservoirs of the Corporation for the purpose of generating electricity for tramway purposes. Mr. Llewellyn Fell says: "I have carefully gone into the question as to whether the 'compensation water' in Sheffield could be used for electric tramway purposes. As you will see from the report Mr. Marsh has drawn up, the 'compensation water,' which was generally supposed to be wasted, is really being profitably used. The separate sources of supply are so small and so far apart, that they would be useless unless they were centralised; the cost of doing this would be out of all proportion to the value of the power gained. Apparently, if the water was collected from all the available sources, only 483 H.P. could be obtained, for which no less than £116,000 would have to be paid (this sum would not include the cost of the power house site, power house buildings, turbines, dynamos, switchboards, &c.); the interest on this sum would be a fixed sum, whether the tramways were not running or were using the full available horse-power. A great point with regard to generating electricity cheaply for tramway purposes is to obtain a plant which will work economically when the load is very small; the average load on a tramway plant is about 50 to 60 per cent. of the maximum load during the 5,720 hours per annum the tramways might be run, so that during, say, 18 hours per day at least, 40 per cent. of the water would be wasted, and during six hours per day the whole of the water would be wasted. If the power was generated by steam, coal would only have to be provided for 60 per cent. of 483 H.P.—289 H.P. The coal required to produce this power would amount to 1,471 tons, at, say, 8s. per ton—£588 12s., the water evaporated would be 3,160,306 gallons, at, say, 2d. per 1,000 –£27 11s., total, £616 3s. This sum does not include the cost of power house site, buildings, engines, boilers, condensers, &c. These would cost about £5,000 more for this plant than that required for water-power. The cost of labour would be rather less if water-power was used, as no stokers would be required. As the Nether Edge and Tinsley routes will require a maximum power of about 500 H.P., the available water power would hardly be sufficient to run this line alone." Mr. Marsh's first report is a detailed and technical calculation of the amount of water-power available, namely, 483 horse-power, and the cost of centralising it, £116,600; which figures form the basis of Mr. Llewellyn Fell's report. Mr. Marsh gave it as his opinion, as water engineer, that the water supply to the town could not be utilised as a generating power. The Traction Sub-committee discussed the report at full length on March 22nd, and adjourned without coming to any definite decision. They gave instructions, however, that further reports should be submitted, showing the water-power available immediately below the embankment of the Redmires and Rivelin reservoirs, instead of centralisation. Mr. Marsh, in his second report, says that as these reservoirs vary from top water to draw-off line at different seasons of the year, he fails to see how it can be expedient or economical to use such a variable motive power. However, calculations on the suggested basis show that 109 H.P. would be available. Mr. Fell agreed with Mr. Marsh that the power obtainable from the Redmires, Rivelin, and Rivelin compensation system sources of supply would not be worth transmitting, as it is so small. Thereupon the Traction Sub-committee instructed the town clerk to write to two experts, and ask what their fee would be for visiting the reservoirs, and reporting as to the water-power available, and he was also instructed to write to a firm of hydraulic engineers and ask whether a greater horse-power could be obtained by turbines than that estimated by Mr. Marsh and Mr. Fell. The Sub-committee again met on May 3rd, 1898, and having received replies from the two experts, decided to recommend that Mr. Frederick Nell, 97, Queen Victoria Street, London, be requested to come down to Sheffield and report upon the question of utilising the water-power of the city for generating electricity, at a fee of £2 2s. per day and out-of-pocket expenses. A letter was read from the firm of hydraulic engineers, that the Committee could not depend on any greater power than that indicated in the reports; and that, in their opinion, the power would be much more cheaply obtained by the use of steam engines. The general report of the Traction Sub-committee to the Tramways Committee was as follows:—"They recommend that the city surveyor be authorised to proceed with the concrete foundations for the power station building at Kelham Island, at an estimated cost of £500, using, as far as possible, the old materials on the ground, and that he be authorised to prepare estimates for the superstructure according to the plans produced, and to advertise for tenders, and it is recommended that the Committee be authorised to affix the corporate common seal to the contract for the building as soon as a tender is accepted. The city surveyor has presented a preliminary plan, showing how the present depôt at Tinsley could be utilised as a large car shed. This plan showed that by lowering the rails under the present shed, and slightly altering the buildings and extending the shed, 30 cars could be accommodated; that by removing the stables and foreman's house on the south-west of the present shed, and erecting another similar roof, 30 more cars could be accommodated, making 60 in all, still retaining space for the repair shops and the long range of stables on the north side of the site; that by removing the last-named stables space could be provided for 20 more cars (making 80), or larger repair shops, stores, and a foreman's house could be erected; also, that by acquiring about 1,100 yards of vacant land between the south boundary of the present depôt and Weedon Street, and removing the repair shop to the north side of the depôt, the number of cars provided for might be increased to 100. The sub-committee recommend that the chairman and the city surveyor be authorised to open negotiations for the purchase of additional land. Letters from the British Thomson-Houston Company show that the sub-contractors they propose to employ under the

contract are as follows:—Messrs. Milnes, for car bodies and cars; Messrs. Brown, for boilers; Messrs. Allis, for engines; Messrs. Spencer, for poles and brackets; Messrs. Wheeler, for condenser, heater, and filters; Messrs. Pearn, for pumps; Messrs. Ludwig, Lœwe & Co., for electrical apparatus; the General Electrical Company, of Schenectady, for sundries; Davy Bros., Sheffield, water tank; Seebohm & Dieckstal, Sheffield, car wheels; Peckham Truck Company, truck frames.

The Tramway Committee recommended the City Council to authorise the city surveyor—on the advice of the British Thomson-Houston Company's representative—to obtain 10,000 yards of iron tubing lined with cement, required in connection with the tramway extension to Walkley, at an estimated cost of £725; also, that the tender of Messrs. Askham Bros. & Wilson, Limited, for the necessary points and crossings in connection with the extension to Walkley from High Street, amounting to £946 13s., be accepted; further, that an order be given to Messrs. George F. Milnes & Co. for 13 double-deck car bodies at £200 each, exclusive of truck and electrical equipment; and that price and designs be obtained from the same firm for 12 single-deck cars, all of which are required for the Walkley extensions; also, that a sub-committee be appointed to settle the principle as to street improvements and tramways construction.

South Staffordshire.—The British Electric Traction Company have had their plans passed by the Brierley Hill District Council for the erection of a generating station, car shed, &c., to equip the electric tramway from Hart's Hill to Stourbridge, which is to take the place of the existing steam tramway.

The Surrey and Middlesex Light Railways Bill.—The opposition to the proposals of the London United Tramways Company to construct a light railway, with electric traction, from Kew over Richmond Hill, thence to Ham, Kingston, and Hampton Court, has, this week, so far as Richmond is concerned, taken a more tangible form. On Friday evening, a well attended meeting of the Tradesmen's Association, at which most of the leading firms were represented, passed, by 47 votes to 1, a resolution opposing the scheme. Dr. J. E. Shuttleworth, a local resident, whose views are worthy of attention, has condemned the proposal on the grounds that there is ample communication with Kingston and Hampton Court by road, rail, and river, and the Light Railways Act was never intended to apply in such a case; that the landscapes of the hill will be destroyed, the residential value of the hill and its approaches affected, and that the working of the railway will be a source of danger. The Richmond Town Council, on Monday evening, on the recommendation of the Amenities and the Parliamentary Committee, decided by an almost unanimous vote to oppose; the Surrey County Council on Tuesday also decided in a like manner; and the Richmond Vestry has passed resolutions in opposition. Meetings of residents in some of the roads affected have also condemned the scheme. A party in favour of the proposal has come forward with the suggestion to cut a new road through some of the old and congested portions of Richmond, in order to bring the line from the terminus of the present tramway along under the hill and so on to Kingston, but this idea is also condemned.

Sydney.—In the course of the presidential address at the meeting of the Electrical Association of New South Wales on March 25th, Mr. Callender, in referring to electric tramways, said that the chief development affecting engineers during the year had been the extension of the system of electric tramways in Sydney, and when the large power house now under course of construction at Ultimo was completed, it would be seen that, although Sydney had waited long and hastened slowly in this matter, the works now being erected would be such as to challenge comparison with the tramways of any city in the world, and it was a matter for congratulation that the whole of the electrical details of the work are in the hands of members of the association.

Tunbridge Wells.—The Town Council has been approached by the Electric Extension Company with a view of establishing an electric tramway in Tunbridge Wells, and the application has been delegated to a committee to report upon the matter.

Walton-on-Naze.—Messrs. Lowden Bros., of Dundee, have been engaged to supply the apparatus for working the electric cars on the pier, and also for lighting the structure. For the present the dynamos will be placed on the wharf near the Pier Hotel.

Waterford.—The Corporation of the City of Waterford have just completed terms with a Dublin syndicate for the purpose of running an electric tramway through the city. The length of track will be about two and a half miles, starting from the Waterford, Dungarvan and Lismore railway terminus, and on the one hand going as far as the Waterford and Tramore railway station, with a branch to the top of Newtown, one of the best suburbs in the city. The capital of the proposed company will be about £22,000, and the promoter, who is a Dublin gentleman, is very sanguine of success in his undertaking. The Corporation have agreed to give the space in the streets at a nominal rent of £1 per year for the first 10 years, after which period a percentage on the profits will be paid to the municipality. It is probable that the work of constructing the line will commence within the next three months.

TELEGRAPH AND TELEPHONE NOTES.

The Blantyre and Umtali Telegraph.—The Marquis of Salisbury has congratulated the British South Africa Company and the Trans-continental Telegraph Company upon the successful telegraphic connection of the British Central Africa Protectorate and of the company's territory north of the Zambesi with the rest of the world.

The Telegraph Wire Export Trade.—The fluctuating character of the export trade of this country in telegraph wire and apparatus connected therewith is well shown by the returns just issued for the month of April last, which show a total of only £64,883, as compared with £125,583 in the preceding month, and £75,688 in April last year. The exports during the four months ending with April, are behind those of last year, having amounted to only £313,671 as compared with £321,160 in the first four months of 1897. Trade was, however, better than in 1896, during the first four months of which year, the exports only amounted in value to £211,368.

Indian Telegraph Appointments.—Three appointments in the Indian Telegraph Department are to be offered to students who join the Cooper's Hill College in 1898.

Interruptions to Australian Landlines.—The *Empire* takes strong views on this subject, as will be gathered from the following quotation, which, however, does exaggerate the general feeling in this case:—"Speaking upon the incessant interruption of the telegraph service between Port Darwin and Adelaide, Dr. Cockburn, who has control of the telegraph lines in South Australia, stated that he was fully impressed with the necessity of making an improvement in the service, and as soon as he returns to Adelaide he proposes to make arrangements for running a second line between Adelaide and Port Darwin. The wire will be carried on the same posts as the existing one, but where the telegraph crosses a watercourse the lines will be separated—one being carried up or down the stream as the case might be, about a mile or two away from the other, to lessen the risk of both lines being taken away by the floods. The line thus diverted will be carried across the watercourse on strong stout posts to prevent their being easily washed away. This 'reform' of the cable scandal is farcical. It reminds one of the philanthropic youth who offered a blind man a pair of spectacles! A few miles of wire along a stream will not relieve merchants from the exorbitant tariffs, or prevent the delays which are constantly occurring. But it will enable the South Australian authorities and the Eastern Company to protect their private interests. That is all they care about."

Parliament and the Telephone.—In the House of Commons last Friday, early in the sitting, Mr. Swift MacNeill made reference to a notice of motion down on the paper on the part of the Government, which notice was to the following effect:—"That a Select Committee be appointed to inquire and report whether the telephone service is or is calculated to become of such general benefit as to justify its being undertaken by municipal and other local authorities, regard being had to local finance; and, if so, whether such local authorities should have power to undertake such service in the districts of other local authorities outside the area of their own jurisdiction, but comprised wholly or partially in the same telephone area, and what powers, duties, and obligations ought to be conferred or imposed upon such local authorities:—That the Minutes of Evidence taken before the Select Committee on the telephone service in the session of 1895, and the report of the Commissioner and the evidence taken before him in the inquiry recently held at Glasgow be referred to the committee for consideration in so far as they relate to the subject of the present inquiry:—That the committee do consist of 17 members, and that Mr. Bartley, Mr. Griffith-Boscawen, Sir Harry Bullard, Mr. Cawley, Mr. Cohen, Mr. Culville, Sir James Fergusson, Mr. Firbank, Mr. Fry, Mr. Hanbury, Sir Reginald Hanson, Sir Henry Howorth, Sir James Joicey, Mr. John Redmond, Mr. James Stuart, Mr. Tully and Sir James Woodhouse be members of the committee."—Mr. MacNeill wished to know whether the Government intended to persist in the nomination of Sir James Fergusson, seeing that he was a director of the National Telephone Company, and as such an interested party. Sir James Fergusson, interposing, explained that he had only allowed his name to be put down in consequence of a request made to him on behalf of the Government, but on further consideration he had decided not to accept the nomination. The matter then dropped. We now learn that Mr. Donald Nicol will take Sir James's seat on the Committee, which was duly appointed on Monday last.

The Surveys of the Pacific Ocean — English and American.—In 1887 at the Imperial Colonial Conference held in London, it was unanimously resolved that a survey for a cable to connect Canada with Australia should be carried out by Her Majesty's Government. This survey is only about two-thirds completed at present. On March 2nd, 1891, an Act was passed by the American Legislature "To enable the President to cause careful soundings to be made between San Francisco, Cal., and Honolulu, in the Kingdom of the Hawaiian Islands, for the purpose of determining the practicability of the laying of a telegraphic cable between these points." This survey was thoroughly carried out and completed in May, 1892; the distance surveyed being about half of that accomplished for the English Government during the last 10 years. We extract the following from an Australian paper, dated March 25th last:—"Surveying cruise of H.M.S. *Penguin*.—H.M.S. *Penguin* yesterday returned to port after a cruise of not quite a year, during which a great deal of hard work has been done. The *Penguin* is well-known

on the station as belonging to that class of ships devoted to taking soundings, charting work, and the investigation or discovery of supposed or actual dangers to navigation. Since she left here in April of last year the *Penguin* has covered many thousands of miles of ocean. Her special duty was to test the route for a cable to connect Australia with England *viâ* America, and she carried out the work as far as Honolulu. The testimony of her officers yesterday was that from a practicable point of view the Pacific route for a cable offers no obstacles whatever. From Sydney she went to Fiji, running a line of soundings all the way; from Fiji to Fanning Island, one of the islands under the British flag. That island was thoroughly surveyed, and found to be suitable for a cable station. To Honolulu from this island the ground was found good for cable work. After refitting at the Sandwich Islands capital, the trip across from Sydney having occupied 14 weeks, a start was made for Palmyra. This island the Americans claimed, it having been discovered by the captain of the barque *Palmyra* in 1802, but was ceded to England in 1889. The island was entirely unsuited for a cable station however, having neither a landing place nor vegetation upon it—desolate in fact—so nothing further was done there. The *Penguin* then returned to Fiji, and made a six weeks' survey of reported dangers to the north and north-west of that group, fixing positions, &c."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cayenne-Pinheiro ...	March 24th, 1898 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Cable beyond Gurupa ...	April 4th, 1898 ...	
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Cape Town-Mossamedes ...	„ 14th, 1898 ...	May 5th, 1898
Maranham-Para	„ 17th, 1898 ...	...
Benguela-Mossamedes ...	„ 20th, 1898 ...	May 5th, 1898
Kotonou-San Thomé ...	„ 27th, 1898 ...	...
Hong Kong-Manilla... ...	May 3rd, 1898 ...	...
San Thomé-Loanda... ...	„ 4th, 1898 ...	...
Monte Video-Rio Grande ...	„ 9th, 1898 ...	...
Havre-Waterville	„ 10th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Majunga-Tananarive ...	May 5th, 1898	May 9th, 1898
Vladivostock-Khabarowka ...	„ 7th, 1898 ...	„ 7th, 1898
Saigon-Bangkok	„ 10th, 1898 ...	„ 11th, 1898

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—May 25th. The date for the receipt of tenders for the electric lighting plant at the railway station at Ghent (Gand-Sud) for the Belgian State Railway Authorities has been fixed for May 25th.

Belgium.—May 31st. The Municipal Authorities of Ixelles, a suburb of Brussels, are inviting tenders until May 31st for the exclusive concession for the supply of electrical energy for lighting and power purposes during a period of 26 years, that is, to September 1st, 1924. Tenders to be sent to the Secretariat de la Commune d'Ixelles, Brussels, from whence particulars may be obtained.

Blackburn.—May 17th. The Committee of St. George's Presbyterian Church invites tenders for the electric lighting of the Church. See our "Official Notices" last week for details.

Bury St. Edmunds.—June 13th. The Corporation invites tenders for the supply and erection of Lancashire boilers, three 60-kw. steam dynamos, transformer and booster, accumulators, street mains, and various other machinery and apparatus for the electricity undertaking. Consulting engineer, Mr. F. H. Medhurst, 13, Victoria Street, S.W. See our "Official Notices" this week.

Coventry.—June 7th. The Electric Lighting Committee invites tenders for electric mains, switchboards, arc lamps, posts and apparatus in connection therewith. For particulars of the several sections see our "Official Notices" this week. Mr. Gilbert S. Ram, city electrical engineer.

Dublin.—May 23rd. The Corporation wants tenders for the supply of high tension feeders and low tension distributors laid and jointed complete on a solid system, not including road work, but including the connecting up of existing consumers to the new mains. Also for transformers (20 to 50 kw., about 700 kw. in all) with instruments and apparatus in sub-stations erected and fitted complete. Particulars at the office of the city engineer; or from Prof. Kennedy, 17, Victoria Street, S.W. See our "Official Notices" last week for particulars.

France.—May 21st. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply, in 10 lots, of 111 kilometres of paper-insulated electric cables. Particulars may be obtained from, and tenders to be sent to, Le Sous-Secretariat, d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

London.—May 17th. The Bethnal Green Board of Guardians invites tenders for the supply of plant, and installing the electric light at the new infirmary, Palestine Place. Plans, &c., to be obtained from the architects, Giles, Gough & Trollope, 28, Craven Street, Charing Cross, W.C. See our "Official Notices" April 22nd for particulars.

Russia.—May 27th. Tenders are being invited by the Municipal Authorities of Odessa for the concession for the construction and working of three lines of electric tramways in the town, the total length being about 39 versts. Particulars may be obtained from La Mairie d'Odessa, Russia, to whom tenders are to be sent.

Southampton.—May 18th. The Corporation invites tenders for the purchase of a Robey slow-speed horizontal steam engine. Particulars from the electrical engineer, Mr. J. H. Lee. See our "Official Notices" this week.

Sunderland.—May 27th. The Corporation invites tenders for the supply of steam and other piping, and water softener for the electricity works. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" for particulars.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

CLOSED.

Belfast.—The Corporation has given Messrs. Victor Coates & Co., Limited, an order for an additional Lancashire boiler for the new electricity station for next winter's load at £666 odd.

Germany.—Messrs. Felix, Singer & Co., of Berlin, have, it is reported, secured a contract for 20 4-wheel motor cars for the light electric railways at present in course of construction in the Mansfeld mining district. The cars, which are for a one-metre gauge, are to be of 40 H.P. each, the motors being on the Walker system.

Glasgow.—The following tenders have been accepted for the erection of a depôt at Springburn in connection with the tramways:—Messrs. John Porter & Sons, £2,500 for the brick and mason work; Messrs. William Shaw & Son, £529 0s. 6d. for the joiner work; Messrs. W. & D. Mailer, £145 13s. 6d. for the slater work; Messrs. P. & W. MacLellan, £336 10s. 7d. for the iron work; Mr. Matthew Sproul, £170 9s. 8d. for the plumber and gasfitting work; and Mr. Peter M'Kerracher, £38 15s. 1d. for the painter work.

Leith.—The Town Council has accepted the tender of the British Insulated Wire Company for the supply, trenching, and laying of the cables throughout the compulsory area with re-instatement of the roads and pathways, and also the supply and erection of the arc lamp-posts amounting to £7,917, in connection with the burgh lighting scheme. An endeavour was made in the Council last week to get rescinded the resolution recently passed by the Council instructing the Electric Light Committee to exercise the utmost economy. It was considered that such a motion hampered the work of the Electric Lighting Committee, and the recision seems to have been carried by six votes to five.

FORTHCOMING EVENTS.

1898.

Friday, May 13th, at 5 p.m.—Physical Society. Paper on "Galvanometers," Part II. By Prof. W. E. Ayrton and Mr. T. Mather.

Monday, May 16th, at 8 p.m.—Society of Arts. "Electric Traction," by Prof. Carus Wilson. Cantor Lecture III.—Energy diagrams—Sub-divisions of energy expenditure—Case when final speed is fixed—Possible ways of reducing the expenditure—Effect of series winding is to reduce the heat loss—Highest economy limited by the weight of the motor—How to find the best values of gear ratio and driving-wheel diameter—Example—The Baltimore and Ohio Railroad—Effect of reduction in train resistance—Use of roller bearings.

Wednesday, May 18th, at 8 p.m.—Society of Arts. "The Evolution of the Cycle," by J. K. Starley. C. V. Boys, F.R.S., will preside.

Thursday, May 19th, at 8 p.m.—Chemical Society, Burlington House. Papers to be read:—"The Action of Formaldehyde on Amines of the Naphthalene Series," by G. T. Morgan, B.Sc.; "On the Constitution of Oleic Acid and its Derivatives," Part I., by F. G. Edmed, B.Sc.

May 19th, at 12 noon.—Federated Institution of Mining Engineers' meeting to be opened at Burlington House, Piccadilly, London. Among papers to be read are:—"Roller Bearings," by Mr. W. B. Marshall; "Gas Power," by J. E. Dowson. Visit to the Central London Railway at 4 p.m.

Friday, May 20th, at 10.30 a.m.—Second day of the Federated Institution of Mining Engineers. Paper by Mr. W. T. Goolden, on "Coal Cutting by Machinery." Mr. W. Dixon's paper on the "Latest Developments and the Practical Application of Alternating Multiphase Machinery for Electric Power Transmission" will be open for discussion.

Saturday, May 21st, at 11 a.m.—Institution of Electrical Engineers. Students' visit to the works of the Electric Welding Company. Applications to join the party should be made at once to the Students' Hon. Sec.

NOTES.

Electrical Matters at Croydon.—The Corporation of Croydon, who have entered into the subject of electricity as applied to municipal purposes with much spirit, and who recently voted nearly £30,000 for the extension of their already considerable electric lighting plant, are likely to entertain, at no distant date, a suggestion to provide electric motive power for the Corporation fire engines. The suggestion emanates from Councillor T. W. Dobson, the chairman of the General Purposes Committee, which has control of the fire brigade, and it is known to have the support of, among others, Alderman Sir F. T. Eldridge, who is an influential member of the Electricity and Lighting Committee. Sir F. T. Eldridge, by the way, is chairman of a special committee appointed by the Corporation to consider the future of the Croydon tramways, the lease of which falls in in August, 1899. The present directors of the Croydon Tramways Company are preparing, in conjunction with Messrs. Kincaid, Waller & Manville, the electrical engineers, a scheme of electric traction for the trams, and are now carrying on private negotiations with the committee referred to.

Electricity in Warfare.—Our American exchanges continue, quite naturally, to devote a good deal of attention to the part being played by electrical men in the war with Spain. That American electrical men have come forward with a will is clear from the ease with which leading electrical companies and their officials have been able to get together various companies of skilled electricians for the purpose of home defence as well as for service in the navy. One contemporary discusses the effect of the war upon the electrical trade. It seems that the very urgent and heavy demands of the Government have led to the cancelling or putting aside of much of the usual business. It might be thought that these orders would make an excess of back work later on, and so keep electrical works fully occupied for a long time to come. Our contemporary thinks otherwise, and suggests that after the Government orders have been executed the electrical business will be in a bad way, as the unsettled state of affairs does not act as an incentive to new electrical enterprise.

Testing Gold Quartz by the Röntgen Rays.—An ingenious application of the Röntgen rays has recently been made, viz., to ascertain the presence of gold particles in quartz. The particles of gold in a paying gold quartz are often so finely divided as to be invisible to the naked eye. Since gold is much more opaque to the Röntgen rays than quartz, it is natural to suppose that some indication of the presence of gold in quartz would be given on the screen or the photographic plate when the quartz is traversed by the Röntgen rays. A physician in Los Angelos, California, is reported on accidentally photographing a lump of gold quartz to have found on the shadow of the outline of the quartz a number of very dark points. These points were due to the presence of particles of gold in the quartz. It is possible, therefore, to detect the presence of gold in quartz by the Röntgen rays, and it may sometimes be convenient in the laboratory, but it is not to be expected that the gold prospector will add a battery, an induction coil, and vacuum tubes to his kit.

The Manila Battle and the Telegraph Cable.—The American naval officers at Manila seem to have known what they were about in cutting the Manila-Hong Kong cable, thus interrupting telegraphic communication between Manila and the rest of the world. From what we have heard privately, they grappled and lifted the cable some miles off the town, in comparatively deep water, and buoyed both ends. They wished to stop the Spaniards from communicating from the Philippine Islands; but, as stated in the *Daily Chronicle*, they had no instruments of their own wherewith to establish communication themselves through the cable, and hence the great suspense and inconvenience which were felt in the United States pending the despatch of the *Hugh McCulloch* from Manila to Hong Kong some days later with news. We hear privately that Commodore Dewey sent ashore and endeavoured to borrow apparatus, and also to secure the services of a skilled operator; but both were refused to him by order of the Spaniards. Some interesting and important international questions are involved in the cutting of a submarine cable belonging to a neutral country in war time by a belligerent. In any case, the importance, from a practical point of view, of equipping every war vessel with the simple apparatus necessary for establishing communication through a cable, when need be, is more than evident. With the old marine galvanometer no readable signals could be obtained, but the Sullivan galvanometer, now used in our Navy, is adapted for both testing and signalling purposes, and with but a little practice, naval men should become expert in exchanging messages through cables, whenever the occasion may arise. We believe our war ships now have the means for grappling cables in shallow or moderate depths of water, as well as suitable electrical apparatus.

Wednesday's *Daily Chronicle* says that the "Eastern Extension Telegraph Company looks to the United States to compensate it for cutting the cable at Manila. But Admiral Dewey did not cut it till the Spanish authorities refused to allow the transmission of American despatches. Therefore the real interruption of the earning capacity of the cable was due to Spanish action, and Lord Tweeddale had better apply for compensation to Madrid."

The Parliamentary Committee.—A further meeting of the Joint Committee on the question of Electrical Supply and Electrical Generating Stations was held on Monday, at which the heads of their report were discussed. A section of the Committee are, according to the *Standard*, in favour of abolishing the present system, by which the power of purchase comes in at the end of 42 years, and of modifying it so that purchase may take place at a shorter period—perhaps 25 years—on the basis of the net profits of that time. This would lessen the burden on the companies by rendering it unnecessary that they should devote so large a part of their income to a sinking fund. Another point raised was the advisability of a sliding scale in regard to the profits of electric companies, like that provided for by the Gas Acts. It is probable that a recommendation in its favour will be adopted. A question has also arisen as to whether, within a fixed radius, a *locus standi* should not be given to adjoining owners to oppose the establishment of generating stations, and also as to whether compensation ought to be paid to adjoining owners in consideration of such nuisances as those which may arise from vibration, &c.

Glasgow Technical College.—The following candidates have been passed for the diploma in electrical engineering, viz.:—John S. Nicholson (Aberdeen), Geo. H. Van Corbach (Shanghai), Wm. N. Brand (Glasgow), J. Bruce Kingsmill (Ireland), Fred. Ussing (Copenhagen). Mr. Nicholson has been nominated for the Sir John Pender Gold Medal, and Mr. David Robertson, jun. (Uddingston), the previous John Pender medallist, for the Pender Scholarship.

The Royal Society.—Among the papers read before this society yesterday afternoon was one by Prof. Gotch, F.R.S., and Mr. G. J. Burch on "The Electrical Response of Nerve to a Single Stimulus Investigated with the Capillary Electrometer. Preliminary Communication," and one by Mr. S. R. Roget on "Effects of Prolonged Heating on the Magnetic Properties of Iron."

The Telephone Question.—There has been published in pursuance of the order of the House of Commons, copy of the agreements entered into on March 25th and 26th, 1896, between the Postmaster-General and the National Telephone Company for the transfer of the trunk lines. The features of greatest interest at the moment will probably be the exchange or "terminal" charges provided for under clause 8, where a telephonic message is transmitted over the trunk wires between an exchange of the National Company and an exchange of the Post Office or some licensee other than the National Company; and clause 18, which says that the agreement shall not prejudice or affect the right of the Postmaster-General to establish telephonic communication himself or license others to do so. The abstracts show that the transfer of lines amounted to nearly 30,000 miles of wire, and when to these are added the lines built by the Post Office themselves, it will be seen how important a branch of the Telegraph Department the trunk telephone lines have become.

Train Lighting.—In a communication to the *Railway World*, Mr. W. Langdon says that few will deny that, to the experiments in the electric lighting of trains carried out by the Midland Railway Company, the industry is much indebted. Those experiments dealt with the subject in such a comprehensive manner, as proved the applicability of electric lighting to the various demands of railway service, and although the circumstances which at that time attended the efforts were such that it was felt advisable to abandon the experiment for the time, the success attending those trials was quite as efficient from a lighting point of view, as that arising from the Stone system. The reason for their withdrawal was not so much one of cost as one of convenience. Mr. Langdon adds: "The rolling stock of a railway is no more exempt from wear and tear than other mechanical appliances, and from time to time vehicles must necessarily come in for repairs. Out of this arises one of two things, either the interposition of unfitted stock, and consequent severance of electrical connection, or the remarshalling of the train at any point at which such unfitted stock has to be interposed." He asks what advantage is possessed by Stone's system over that of the Midland or other systems? "It is based upon the same lines with the exception that whereas in other systems the varying speed is compensated by electrical adjustment, in Messrs. Stone's system it is met by the slip of the belt. There is no doubt that a self-contained system has attractive features from a traffic point of view—it disposes of the remarshalling question, and it is extremely convenient for trial purposes; but conceive a large system, such as the Midland, with all its passenger stock—some 3,800 coaches and vans—fitted with dynamos all arranged below the bed-frame of each vehicle, and set against this the number of electric generators, arranged above board, which would be required if the light were operated on the Midland system—*i.e.*, from one vehicle in each train—and say which ought to prove the most convenient and economical to maintain, 380 generators above board or 3,800 below board." The many trials which are being made by railway companies of Stone's system show how anxious they are to adopt electricity for carriage lighting if its cost is reasonable. That electricity is *the* illuminant for the purpose Mr. Langdon has not the least doubt, but whether it is to be done by fitting each vehicle independently rather than in groups, he considers is open to question.

Wireless Telegraphy.—A demonstration of the Marconi system took place on Thursday last week at the offices of the Wireless Telegraph and Signal Company, Limited, 28, Mark Lane, E.C. Amongst those present were the President of the Board of Trade, the Right Hon. Charles Ritchie, M.P.; Sir Courtenay Boyle, Lord John Hay, Admiral of the Fleet; Lord Kelvin, Sir William des Voeux, Lord Charles Beresford, Lord Stanley, Mr. C. Farquhar, Mr. E. Beaumont, Q.C., Admiral Compton Domvile, Mr. R. G. Hayes, Commander Evan Thomas, Mr. Charles Wilson, M.P., Colonel FitzGeorge, A.D.C., and Captain the Hon. C. Colville. Mr. Marconi was at the transmitting end, and Lord Charles Beresford read the messages printed on Morse tape in another room in the building, all of which were easily decipherable.

The Spiral Globe, Limited.—Since the brief notice in our issue of May 6th of "The Spiral Globe, Limited," we have given careful consideration to the claims advanced in the prospectus of the improvement in the illuminating power of an ordinary incandescent lamp by winding a glass rod spirally round it. The first point we considered was the report of the Electrical Standardising Testing and Training Institution, signed by Mr. Hugh E. Harrison. The net result of the experiments on which the report is based appears to be that if a set of annular glass pieces of circular section are disposed about an irregular source of light, the effect of reflection and refraction at the surfaces of the glass will be to intensify the radiation in both directions along the axis of the annuli, and in consequence, though this is not mentioned here, to reduce the equatorial radiation. Figures are given of four dispositions of such an arrangement about an ordinary incandescent lamp, involving seven experiments. From general considerations of the paths of the rays of light this result seems reasonable, though the disposition of the glass surfaces and the sources of light are too complicated to admit readily of a geometrical investigation. Now of the seven experiments, five, giving three comparisons, deal with the spiral globe in the form in which it is proposed to apply it, and all three show considerable increase of intensity along the axis of the lamp, no reference being made to the necessary consequent equatorial diminution of intensity at right angles to the axis. The other comparison deals with the spiral arranged so as to produce an increased equatorial intensity in one direction only—an arrangement which does not appear to be contemplated in practice, and has no bearing on the matter in question. It is not clear why this is introduced, but it might give an impression to an inexpert reader that the spiral globe increases the equatorial intensity as well as the axial. Consider the general action of lenticular arrangements. They are never introduced to increase the all-round, or average radiation, and must in every case reduce it by the opacity of the glasses and the dirt collected on their surfaces. Their sole purpose is to direct rays of light radiated in a useless direction along a useful one, at the expense of some loss. Now, though this prospectus claims an improved distribution, viz., an increased vertical and a reduced horizontal one, it gives no reason for claiming this to be an improvement, nor can anyone say, for an ordinary incandescent lamp, that any particular direction of radiation will be necessarily more useful to its future purchaser than another. So far as one can say anything, it is that it is not generally convenient to increase the upward radiation at the expense of the horizontal or oblique. To us the modification made does not commend itself. The prospectus further claims that the spiral globe "more than doubles the effective light emitted," "and insures a corresponding economy in the consumption of electrical current." The spiral globe does nothing of the kind. Its effects appear to be three. It will increase the illumination above and below the lamp, where it may or may not be wanted, and diminish it horizontally, with, on the whole, a loss. It will no doubt be a pleasanter and less intense light for rooms, but this advantage is got in many other ways. Its surface, inevitably more or less dirty, will reduce the general efficiency, and when the lamp is placed in an unfavourable position, so that dust accumulates, will do so very largely. It would be very difficult to clean. As far as we see every one of the seven advantages claimed for the globe in the prospectus is ridiculous, looked at from an investor's point of view. If this document is to be construed in the way most convenient to the promoters that its ambiguously qualified claims admit, we can only say it is not a very ingenious specimen of its class. If it is to be construed by the meaning it would convey to an intelligent inexpert reader, it is, to say the least, misleading.

Electric Traction Lectures.—Prof. Schwartz and Dr. D. K. Morris will commence their series of six lectures on "Electric Traction" at the South-Western Polytechnic, Chelsea, on Tuesday next, at 7.30 p.m. The lectures will deal respectively with:—1. Power stations; 2. Overhead conductors; 3. Conduit and surface contact systems—The permanent way; 4. Motors and rolling stock; 5. Accumulator cars; 6. Working expenses—Maintenance and depreciation.

Technical Education in Ireland.—The Dublin Corporation last week passed a lengthy resolution requesting the Government to appoint immediately a committee of eminent educational and scientific authorities, together with representatives of the manufacturing, industrial, and commercial interests in Ireland, to inquire into the question of the need of Ireland in regard to primary, secondary, and higher technical education. The Government is to be asked for a £100,000 grant for the purposes of the Royal College of Science for Ireland. The Lord Mayor of Dublin in a speech upon the subject said: "As regards higher technical education it was certainly little less than a scandal and disgrace to the Government that not a single chair of mechanical or electrical engineering, to say nothing of architecture, existed in the whole of Ireland."

Appointments.—The Glasgow Electricity Committee has passed a recommendation to the Council to appoint Mr. John Christie, of Londonderry, as station engineer, and Mr. J. C. A. Ward, of St. Pancras mains department, as superintendent of mains. The appointments are, of course, subject to confirmation by Council on the 19th inst., but the committee was unanimous in both cases.

Lecture.—Before the Ipswich Scientific Society on 4th inst. Mr. S. A. Norcutt lectured on "Phenomena of Electrical Discharge."

Self-Charging Motor Car.—Mr. L. Epstein has recently patented a new electric motor car, in which he claims to have overcome the difficulties presented by batteries becoming exhausted at a distance from a charging station. It is admitted that it is one of the great drawbacks of electric motor cars that the batteries require periodical re-charging, this necessitating the existence of charging stations, and considerable rough usage of the accumulators in taking them out for charging and putting back in position again. These drawbacks are said to be avoided by the Epstein motor car, which is self-charging, inasmuch as it is equipped with the necessary apparatus for automatically charging the cells whenever and wherever required, with very little difficulty. The car is equipped with Epstein cells of a special type, and an oil engine, and the motor can be reversed for use as a dynamo for the purpose of charging the cells. The extra equipment is stated to be responsible for an additional weight of only 3 per cent., compared with the ordinary electric motor car. The weight of a self-charging car, complete with all equipment and four passengers, comes out at something under 30 cwt. The accumulators weigh 7 cwt., and are considered sufficient for a 60-mile run on ordinary roads. We understand that Mr. Epstein now has one of the cars in course of construction.

Pacific Cable.—A daily paper says that the British ship *Penguin*, which had to take soundings and to investigate the bottom of the Pacific, with the view to the laying of a cable, arrived at Sydney on March 25th. According to the *Frankfurter Zeitung*, her officers declared that the soundings showed no obstacles.

Appointment Vacant.—The Stockport Gas and Electric Light Committee want a clerk of works at £3 per week. See our "Official Notices" this week for particulars.

The Electrical Press.—The number of journals partly or wholly devoted to electrical subjects amount in the total to 66. Of these 18 are published in France, 14 in the United States, 12 in Germany, 6 in England, 3 in Switzerland, 2 each in Austria, Belgium, Holland, Italy and Spain, 1 each in Canada, Japan, and Russia.

The Pender Memorial.—One of the two marble busts of the late Sir John Pender, G.C.M.G., executed by Mr. E. Onslow Ford, has now been received by the authorities of University College, London. The bust has been placed in the library. The likeness is stated to be a pleasing and striking one. The second bust is at present on view at the New Gallery, and will afterwards be sent to Manchester for exhibition.

Calcutta University.—The Senate of this University is considering the subject of degrees in science. The committee appointed to report on the subject considers, says an Indian journal, the institution of such degrees desirable for the encouragement of original research by the graduates of the University.

Dust Destructors in India.—The Vizagapatam Municipal Council has resolved to construct a Roberts's patent incinerator. An Indian exchange says that this will minimise the difficulty now felt by the Council in the proper disposal of rubbish, the present sites in town having been condemned by that officer.

King's College Old Boys.—We hear that Mr. W. H. Preece is to preside at the King's College School Old Boys' annual dinner at the Criterion Restaurant on Friday next, May 20th.

NEW COMPANIES REGISTERED.

Chilian Electric Tramway and Light Company, Limited (57,203).—Registered May 3rd, with capital £1,050,000 in £1 shares (550,000 preference), to adopt an agreement with the Allgemeine Electricität's Gesellschaft, of Berlin, to acquire, equip, maintain and work by horse, electrical, steam, or other power, any tramways or railways in Chili or elsewhere in America, and to carry on the business of electricians, electrical engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—E. F. Rouse, 1, Avenue Gardens, Mill Hill Park, W., gentleman; W. G. Turnbull, 95, Wood Lane, Shepherd's Bush, W., clerk; G. F. Barnett, 12, Weston Park, Crouch End, N., clerk; J. Jewell, 13, Richmond Crescent, Barnsbury, clerk; C. Field, 27, St. Margaret's Road, Brockley, S.E., clerk; H. A. Milner, 84, Effingham Road, Hornsey, N., clerk; W. MacGillivray, 368, Green Lanes, N., book-keeper. The number of directors is not to be less than six nor more than 12; the subscribers are to appoint the first; qualification, £500; remuneration as the company may decide. Registered by Ingle, Holmes & Son, 20, Threadneedle Street, E.C.

Silverton Ironworks, Limited (57,218).—Registered May 4th, with capital £50,000 in £1 shares (10,000 preference), to adopt an agreement with F. O'C. Prince for the acquisition of an invention for improvements in furnace bars, and to carry on the business of mechanical engineers, machinists, wood workers, builders, timber merchants, electrical engineers, chemical manufacturers, &c. The subscribers (with one share each) are:—T. Willson, 2, Christchurch Road, Hampstead, architect; H. Howe, 6, Epirus Road, Walham Green, S.W., gentleman; A. R. Stanes, The Limes, Surbiton, merchant; L. F. Clow, 8, Old Jewry, E.C., land agent; F. O'C. Prince, 37, Cursitor Street, E.C., engineer; E. J. V. Davies, 1, Harringay Villas, N., engineer; A. E. Bloxham, 17, Boveney Road, Honor Oak Park, S.E., agent. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 400 ordinary or 200 preference shares; remuneration, £100 each per annum (£150 for the chairman), and a percentage of the profits. Registered by N. L. Pocock, 16, Finsbury Circus, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cambridge Electric Supply Company, Limited (36,457).—This company's annual return was filed on March 2nd; 9,413 shares have been taken up out of a capital of £100,000 in £10 shares; £8 per share has been called on 4,970, and £1 per share on the others, and £44,203 has been paid.

Telegraph Construction and Maintenance Company, Limited (1,147 C).—This company's annual return was filed on March 23rd, when the whole capital of £448,200 in £12 shares was taken up and paid for in full.

W. T. Henley's Telegraph Works Company, Limited (13,795).—This company's return was filed on March 18th. The capital is £180,000 in £10 shares (3,000 preference), 12,500 ordinary and 3,000 preference have been taken up, and £155,000 has been paid.

British Insulated Wire Company, Limited (52,285).—This company's annual return was filed on April 15th. The capital is £400,000 in £5 shares (40,000 preference). 20,000 preference and 40,000 ordinary shares have been taken up, and 5,530 preference and 29,935 ordinary are considered as paid. £2 15s. per share has been called on the others, and £67,471 5s. has been paid, leaving £55,203 15s. in arrears.

CITY NOTES.

The West India and Panama Telegraph Company, Limited.

The directors' report for the half-year ended December 31st, 1897, to be submitted to the shareholders on May 18th reads as follows:—The directors submit the accounts for the six months ended December 31st, 1897. The amount to credit of revenue is £32,228 11s. 8d. against £34,053 13s. 6d. for the corresponding half-year of 1896, and the expenses have been £19,772 15s. against £21,393 15s. 4d., leaving a balance of £12,455 16s. 8d., which, with £1,243 6s. 8d. brought from last account, and £1,000 transferred from reserve account, makes a total of £14,699 3s. 4d., with which it is proposed to deal as follows:—

	£	s.	d.
First preference shares—			
Dividend, six months to December 31st, 6s. per share	10,388	18	0
Second preference shares—			
Dividend, six months to December 31st, 6s. per share	1,400	14	0
Ordinary shares—			
6d. per share (free of income-tax)	2,208	0	6
Balance to current half-year's account	721	10	10
	£14,699	3	4

The traffic receipts for the six months show a decrease of £2,187 19s. 8d., as compared with the corresponding period, attributable to the causes mentioned in the last report, and to the depressed condition of West Indian trade. The expenses of repairing cables during the half-year are £1,386 15s. 3d. less than those for the corresponding period. During the half-year the company's two repairing steamers, *Grappler* and *Duchess of Marlborough*, have been surveyed and repaired in accordance with Lloyd's requirements. The new cable between Bermuda and Jamaica, alluded to at the last general meeting, was opened for traffic on January 31st. The contract between Her Majesty's Government and the new company provides for a subsidy of £8,000 per annum, and for a maximum tariff of 3s. per word between London and Jamaica, as against 5s. 10d. per word charged by the route as prescribed by the Legislative Acts of the Colonies, *vid* Havana. The directors, however, decided to make corresponding reductions of rates to and from the West Indies on January 1st. With the view of aiding the plans of the Government in furtherance of West Indian trade, reductions of inter-colonial rates were also made on April 1st. Since the last general meeting the directors, with the object of maintaining and strengthening the duplicate system, have made arrangements to connect Grenada, St. Lucia and St. Croix, by a new line of cable in substitution for the old Chord line, which has proved to be beyond repair, and to duplicate the Trinidad-Grenada section. A contract has also been entered into for the manufacture and delivery in the West Indies of 160 knots of cable for stock. Owing to the financial crisis through which the Leeward Islands are now passing, Antigua and St. Kitts have reduced their subsidies from £800 to £600 each for the current year. Notice has also been received from the Government of Jamaica that the subsidy of £2,000 per annum, hitherto paid to this company, has ceased from March 31st. In accordance with the articles of association, Henry Holmes, Esq., retires at this meeting, and offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths and Co., also retire, and offer themselves for re-election.

The Great Northern Telegraph Company of Copenhagen.

The general meeting of this company was held at Copenhagen on April 30th, 1898, Mr. F. Zahle presiding.

The chairman and managing director, Commodore E. Suenson, D.R.N, in rendering an account of the working of the company during the year 1897, stated that the state of the cables in Europe had not been satisfactory during 1897, especially towards the end of the year. No fewer than 11 of the cables had been interrupted, the total number of interruptions being 32. These had nearly all been due to injury caused by the fishing vessels, especially by the steam trawlers, which are spreading more and more, not only over the North Sea, but also in the Skager Rack and Kattegat. On the other hand, the cables in the Far East had been comparately free from injury, thanks to the extensive strengthenings and renewals which had been carried out during the last years, particularly on the Hong Kong-Amoy-Shanghai line. There had been only seven interruptions, affecting five cables. Unfortunately the Wladiwostock route had, as usual, been the weak link in the system. An altogether exceptional inundation of the Amur River had to a great extent destroyed the work of reconstruction carried on by the Russian Administration, and the work had to be done afresh. This reconstruction would, he hoped, put an end to the repeated interruptions of this route, while, as the construction of the railway in Siberia advances, the maintenance of the line would be facilitated. Their telegraph system in Europe would be improved in course of the present year, thanks to a measure contemplated by the Swedish Administration, viz., the building of bronze wires across Sweden. This would be of great advantage to the considerable traffic crossing that country between Gothenburg and Grisiebamn. Similarly the Danish Administration had improved the lines across Denmark by the introduction of oil insulators; while the Russian Administration had built a new direct line between Moscow and Libau in order to accelerate the transmission of the telegraph traffic with the central and southern parts of Russia. The continued commercial and industrial development of China and Japan, and, during the last months of the year, the political events in the Far East had tended to increase the traffic. The friendly relations established with the Chinese Administration in 1896, by the convention concerning the traffic exchanged between Europe and China, which was mentioned in the last report, had been further consolidated by a similar convention concerning the limitrophic traffic between the Russian and Chinese Empires. In Japan they had had protracted negotiations with the Telegraph Administration, complicated by the introduction of the gold standard into that country. These negotiations eventually led to a tariff arrangement, which had also contributed to develop the traffic. Speaking of the projected Iceland cable, the Chairman said as the cable would render important service to Great Britain, France, and others, which every year send a number of fishing vessels to the coast of Iceland with crews numbering thousands of men, the company had provisionally approached Great Britain, France, and Russia in the hope of obtaining in return for the free transmission of their meteorological telegrams a fixed yearly remuneration which might contribute towards making up the deficiency in the receipts. The financial result of the year has been very satisfactory. The decrease in the receipts was only apparent, and was due merely to a change in the method of making up the accounts and balance-sheet. The interest on investments belonging to the reserve and renewal fund had been added direct to this fund, instead of being, as before, first entered in the working account. The latter method, which was less correct, was followed for so long a time, only with the object of enabling the employment of a larger amount for the amortisation of the debentures, but as the whole debt of the company would probably be extinguished in the course of another 12 months, the more correct method has been introduced this year. This alteration has not affected the extra dividend, which has been fixed as last year at 10s., making a total dividend of 10 per cent., or 20s., whilst the reserve and renewal fund has been increased by an amount slightly smaller than ordinarily.

The accounts were then adopted, and the retiring directors and auditors were re-elected.

The Eastern Extension, Australasian and China Telegraph Company.

The forty-ninth half-yearly meeting of the above company was held on Wednesday last at Winchester House, Old Broad Street, the Marquis of Tweeddale presiding.

The Chairman, in moving the adoption of the report, said: Gentlemen, the gross revenue for the half-year under review has amounted to £275,142, or a decrease of £50,263. Of this, £20,000 was caused by the falling off of the Australian traffic, which we have always pointed out to you is more or less of a temporary character, the remainder being due to reductions of tariff. When these reductions were made, it was estimated that there would be a loss of over £55,000, and it is most gratifying, I think, to find that the falling off in revenue from this cause has not been nearly so great as was anticipated. The working and other expenses have amounted to £102,844, showing a decrease of £3,426, which is due to the cost of maintenance of cables and expenses in connection with negotiations having been less in the past half-year than in the corresponding half-year of 1896. The usual interim dividends have been distributed during the past year, making, with a final dividend proposed to be paid to-morrow, a total payment of 5 per cent. for 1896; a bonus of 4s. per share, or 2 per cent. will also be paid, making a total distribution for the year of 7 per cent. The revenue balance, amounting to £57,444 13s. 10d., has been carried to the general reserve fund, which now stands at £803,667, after having been debited with £79,619 for the cost of the cable renewals, &c., carried out during the half-year under review. These renewals have been made in the Malacca Straits and China seas, and during the current year it is proposed to carry out several other much-needed renewals in various sections of the company's system. A further drawing by lot of the company's Australasian Government subsidy debentures (451 in number) took place on the 4th ult. for payment at par on July 1st next, when the debenture debt, which originally amounted to £640,000, will be reduced to £80,600. When I last had the pleasure of addressing you, I referred to the subsidy arrangement entered into with the Spanish Government for extending the company's system from Manila to the islands of Panay, Negros, and Cebu. During the half-year under review, this contract was completed to the satisfaction of the Spanish Government, and the cables opened for traffic. Unfortunately, however, through a further outbreak of the rebellion in the Philippines, one of the new stations in Cebu (Tuburan) has had to be abandoned, and is reported to have since been entirely destroyed, and until the rising is quelled, or sufficient troops can be spared to garrison the place, the working of the station cannot be resumed. Our Bolinao station, where the Hong Kong cable was originally landed, was also in the greatest danger a few months ago, owing to large numbers of the rebels having assembled in the neighbourhood, and demanded the surrender of the Spanish soldiers (11 in number) who had been sent to Bolinao to protect it. The Government landlines between Bolinao and Manila had been cut by the rebels, so that it was quite impossible for the station to communicate with the authorities at Manila by telegraph. For four days the station was entirely surrounded by the insurgents, who constantly threatened to attack it, and but for the timely arrival of a Spanish gunboat the station must have surrendered, with the result that the soldiers would doubtless have shared the sad fate of the other small garrisons

in the district, who, after receiving promises of safety, were cruelly murdered. During this trying time the company's staff at Bolinao displayed the greatest courage and loyalty, and we understand that the Governor-General has recommended the Spanish Government to recognise their valuable services by conferring upon the superintendent and other principal members of the staff suitable decorations. The insecurity of the landline between Bolinao and Manila had long been recognised by the Government and mercantile community of Manila, and many proposals had been made from time to time for improving it, but without any practical result. The troubles, however, to which I have just referred were the means of bringing the negotiations between the company and the Spanish Government to a head, and a contract was entered into on March 30th for cutting the Hong Kong cable off Bolinao and extending it direct to Manila in return for certain concessionary privileges. The work was carried out within a fortnight of the contract being signed, and the Bolinao station and staff removed to Manila. They had not, however, been working from Manila many weeks before hostilities broke out between the United States and Spain, and on Monday, the 2nd inst., at 8 p.m., the cable was suddenly interrupted close to Manila, we believe by the order of the admiral of the American fleet. Should this prove to be the case, we shall naturally look, and with the utmost confidence, to the Government of the United States to compensate us for the damage caused to our property. Communication by cable between Manila and Hong-Kong will not be restored, I am afraid, until we are in a position to repair the cable, and until peace has been restored between the two belligerents, which, I am sure, we all hope will soon be the case. You will have seen from the newspapers that the proposal which the Eastern, Eastern Extension, and South African Companies submitted to Her Majesty's Government for establishing an all-British cable between this country and Australia *vid* the Cape of Good Hope, has of late received a good deal of attention both in the colonies and on this side, but up to the present time the departmental committee has not made its report, and consequently no definite result has been arrived at. You will remember that at the last meeting a suggestion was made to the board that the services of the staff should be specially recognised in connection with the celebration of the Queen's Jubilee. This suggestion, after receiving the board's careful consideration, was adopted, by the granting of bonuses to the whole of the company's employés, and the expenditure incurred will appear in the accounts for the current half-year.

Mr. F. A. Bevan seconded the motion, and the report was adopted.

The retiring directors and the auditors having been re-elected, the proceedings terminated with a vote of thanks to the chairman and directors and to the staff.

American Bell Telephone Company.

The American Bell Telephone Company's report for the year 1897, gives the estimated number of exchange connections in the United States as 998 millions; the increase in the number of subscribers reported by the licensee companies was unprecedented in the history of the business, the gain in the last two years having equalled the aggregate gain of the previous six years. The number of exchange stations is 384,230, which equals, within a few thousand, the aggregate number of exchange stations in all of Continental Europe. The German Empire is reported to have 122,362 exchange stations (1896), and Great Britain comes next with 85,316. Conversation is now had by subscribers in the United States over distances of 1,800 miles.

West Coast of America Telegraph Company.

Mr. J. Denison Pender presided at a meeting of this company held at the offices of the company, Winchester House, on Tuesday last.

The Chairman referred to the death of Lord Sackville Cecil, one of the directors, whose seat at the board had been filled by Sir Albert J. Leppoc Cappel. The gross receipts for the year amounted to £25,773, being an increase of £2,268 of the previous year under the old company. The expenditure had been £19,476, or a reduction of £2,812, which was attributable to their having only one section of the cables interrupted during the year. The repairing steamer *Retriever* was only away from port five days during the 12 months, thus effecting a great saving in working expenses and maintenance of cable. Taking into consideration the depressed state of trade, the result of the first year's working of the new company could not be considered unsatisfactory. At the same time, the expenses had been abnormally small. The scheme of reconstruction took over the business, goodwill, property and assets, with liabilities of the old company, from December 31st, 1896. Of the share capital, 30,000 shares of £2 10s. each had been allotted to shareholders of the old company, and 15,000 of a similar amount had been allotted to the Brazilian Submarine Company. 8 per cent. debentures had been exchanged for 4 per cent., and £20,000 in 4 per cent. income bonds had been issued. The chairman referred to correspondence which had appeared in the financial press, and described the remarks of the writers as absolutely inaccurate.

Elmore's German and Austro-Hungarian Metal Company, Limited.

Mr. John MacFarlan (chairman) presided over the seventh annual meeting of the above company, held on Wednesday at Winchester House, and in moving the adoption of the report said the reduction of capital had been carried out and the amount standing as cost of patents was reduced from £139,940 to the more reasonable figure of £84,252. At the same time the period during which the preference shares had nine-tenths of the profits had been extended by two years in consideration of the additional sum of £10,000 put in the business. With regard to the Metall Company the result of the year's trade was disappointing as they fully expected the profit would have been sufficient to have paid a dividend. The explanation of the cause of their failure was a simple one. They got the Government contract and were told the requirements would be 100 tons per annum. They quoted a low price in view of the benefit they would derive by getting the contract. The result was that they received orders for more than three times the amount they expected at the lowest price. As soon as they got the Government order they were inundated on all sides with orders, but in consequence of the Government work they could not accept them. The contract with the navy was cancelled by them, and they had secured nearly the whole of the new one, only very small tubes going elsewhere, at prices very much higher than those of the old contract. The fact of their obtaining the new contract proved the esteem in which their tubes were held by the Government. They were informed by the Hamburg-South American Steamship Company that they had specified in their contract that only tubes of their make should be used. The most important fact of all was that they were now in a position to give orders for a very considerable extension of their plant, and they were now completing the erection of new plant which would enable them to about double the sales of last year. They had erected a very large draw bench shed, and filled it with draw benches, and they had built a very large double annealing furnace, which with the draw benches was sufficient to deal with the output. They were also deriving considerable benefit from the new arrangements with regard to the purchase of copper, and were now in the happy position of getting all copper free at Schladern at from 30s. to £2 a ton less than the value of Chili bar, and at the same time they paid nothing for the gold and silver it contained. They obtained 391·4 ounces of gold, which was sold for £1,692 3s. 6d., and 11,364·22 ounces of silver, which sold for £1,481 4s. 2d. That was a very important point, as that bye-product increased with increased output. On December 31st they had locked up in copper and book debts no less than £24,512 6s. That sum was considerably greater now, and it was impossible for them to carry out the extension without copper to fill the tanks. The debenture stock fell due for repayment on July 1st, and they proposed to make an issue of £60,000 to replace that. With the increase of business, they felt they were justified in reducing the interest from 8 per cent. to 6 per cent.

Mr. Heal seconded the adoption of the report, and it was agreed to.

Mr. Rawson stated that the shareholders would be glad to hear that the French Elmore Company would probably pay a dividend of between 10 and 20 per cent.

The Western and Brazilian Telegraph Company Limited.—The directors have decided, after placing £5,000 to the reserve fund, to recommend the payment of 6s. 9d. per share, making, with the interim dividend paid in November last, a total distribution of 3½ per cent. for the year 1897. This will give 6s. 9d. to the ordinary, 6s. to the preferred ordinary, and 9d. to the deferred ordinary shareholders.

Stock Exchange Settlements.—Application has been made to the Stock Exchange Committee to allow the following securities to be quoted in the Official List:—Oxford Electric Company, Limited—10,000 shares of £5 each fully paid, and £35,000 4 per cent. debenture stock.

Forthcoming Prospectus.—The various daily and evening papers announce that the Great Northern and City Electric Railway prospectus will shortly be before the public.

New General Traction Company.—The meeting of this company, convened to be held yesterday, was not held, but was postponed until the 17th inst.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending May 6th, 1898, were £2,478 2s. 4d.; corresponding period 1897, £2,271 9s. 5d.; increase, £206 12s. 11d.

The City and South London Railway Company.—The receipts for the week ending May 8th, 1898, were £964; week ending May 9th, 1897, £957; increase, £7; total receipts for half-year, 1898, £19,721; corresponding period, 1897, £19,503; increase, £218.

The Dover Corporation Electric Tramways.—The receipts for the week ending May 7th, 1898, £130 11s. 8d.; total receipts to May 7th, 1898, £2,082 2s. 8d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, May 6th, 1898, were £461 0s. 2d.; corresponding week last year, £511 7s. 2d.; decrease, £50 7s.; passengers carried, 76,828; corresponding week last year, 78,961; aggregate to date, £7,899 17s. 3d.; aggregate to date last year, £8,166 11s.; decrease to date, £336 13s. 9d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending May 8th, 1898, amounted to £1,504; corresponding week last year, £1,316; increase, £188.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending May 6th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,175.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, May 4th.	Closing Quotation, May 11th.	Business done during week ended May 11th, 1898. Highest.	Lowest
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 —104	100 104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5% Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	3 %	60 — 63	63 — 66	63½	62⅝
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	6 %	110½ 111½	113 114	114	111
3,038,020£	Do. do. Defd.	Stock	...	...	...	14 — 14½	15⅜ — 16½	16⅜	14
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	7 %	15⅜ — 16½	15⅜ — 16½	16 1/16	15⅜
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	...	...	112 — 116	112 — 116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	8 %	...	160 —170	160 170	...	...
918,297£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	103 —105	104 —106	105	104
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	7 %	6 — 7	6⅛ — 7⅛	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14 — 15	14½ — 15½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 5,000	50	4½%	4½%	4½%	103 —106%	103 106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10½ — 11	10½ 11	10½	10⅜
120,000	Direct West India Cable 4½% Reg. Deb	100	...	...	...	98 —101	99 —102	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17 — 17½	17⅜	17 1/16
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	18 — 19	18 — 19	18⅝	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5%	...	100 —103	100 —103	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	127 — 130 xd	123 —127	124	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7%	7 %	18 — 18½	18 — 18½	18¼	18
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,276 to 4,326	100	5 %	5%	5 % 5 %	100 —104	100 —104	...	...
100,500£	Do. do. Bearer, 1,050—3,275 and 4,327—6,480	100	5 %	5%	...	101 —104	101 — 104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4%	4 %	127 — 130	127 —130	...	...
35,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1960 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5%	...	100 —104	100 — 104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	101 —104	101 — 104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1929	100	4 %	4%	...	102 —105	102 —105	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	105 —108 xd	105 —108 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	15	4½%	4½%	...	11¼ — 11⅝xd	11¼ — 11⅝	11⅝	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6%	...	16⅜ — 17¼xd	16⅜ — 17¼	17⅛	16⅜
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	10 %	28½ — 29½	28½ — 29½	28 13/16	28½
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	5 %	100 — 103	100 —103	...	...
97,000	Halifax and Bermuda Cable Co., Ltd., 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	97 —102	97 —102	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	...	50 — 53	50 — 53	52½	50
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6%	...	106 — 109	107 —110	109	108
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	4 %	2 — 2½	2 — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5⅛%	5⅛%	6 %	5⅛ — 5⅜	5⅜ — 5⅝	5⅜	5⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛ — 5⅜	5⅜ — 5⅝	5⅝	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —105	99 —104	101½	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝ — ¾ xd	⅝ — ¾	¾	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 — 141	136 — 141	...	...
58,000	United River Plate Teleph., Ltd.	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	105 — 108	105 — 108	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	*nil*	...	3½ — 4½	3½ 4½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	99 — 102	99 102	100	...
64,269	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	...	11½ — 12	12 — 12½	12 5/16	11½
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	...	7½ — 8	7½ — 8	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	...	4⅛ — 4⅜	4⅛ — 4⅜	4⅜	4 7/16
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	105 —108	105 —108	105½	...
88,321	West India and Panama Teleg., Ltd.	10	¾%	1 %	¾ %	⅛ — ¾	⅛ — ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	7⅛ — 7⅜	7⅛ — 7⅜	7⅜	7 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7%	...	105 —110	103 —106	...	...
160,100£	Do. do. 6 % Ster. Bonds	100	6 %	6%	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	7 %	13 — 14	13 — 14	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6¼	6⅜	6
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	6 %	9½ — 10⅛	9½ — 10⅛	10¼	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	115 —117	115 —117	...	...
50,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001— 90,000	10	5 %	7 %	10 %	26 — 27	26 — 27	26⅜	26⅛
10,000	Do. do. Prov. Certs. Nos. 90,001 to 100,000 £5.	10	...	...	...	18 — 19	18 — 19	18½	18
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½ — 18½	17½ — 18½	18¼	17 13/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	129 — 134	...	...
30,000	County of Lond. & Brush Prov. El. Ltg. Ltd., Ord. 1—30,000	10	*nil*	*nil*	*nil*	14 — 15	13½ — 14½	14 9/16	13¾
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 pd.	10	...	...	...	8½ — 9	8½ — 9	...	...
20,000	Do. do. do. 6% Pref., 40,001—60,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15⅜	15 1/16
17,400	Edmundsons Elec. Corp., Ld, ord. shares 1—17,400 £4 pd.	5	...	...	...	4 — 4½	4 — 4½	...	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5			4 %	10 — 11	9½ — 10½	10⅜	9¾
10,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	11 — 12	11 — 12	11 7/16	11½
62,400	*Metropolitan Electric Supply, Ltd., 101 to 62,500	10	4 %	5 %	6 %	18½ — 19½	18 — 19	19⅜	18¼
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½ %	117 — 121	117 —121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2 %	4 %	6 %	19 — 20	19½ — 20½	20½	...
31,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord.	5	7½%	10½%	14½ %	17½ — 18½	17½ — 18½	18⅜	17½
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	4 %	107 —110	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2¼ — 2⅜	2¼ — 2⅜	...	...
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	7 %	9 %	12 %	17 — 18	16 — 17	16½	16¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, May 4th.	Closing Quotation May 11th.	Business done during week ended May 11th, 1898. Highest	Lowest
30,000	British Electric Traction	10	...	...	...	15½ — 16½	15½ — 16½	16¼	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £4 pd. (issued at £2 10s. prem. all paid)	10	...	...	...	7½ — 8½	7 — 8	...	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	5	2½%	*nil*	*nil*	1⅝ — 1⅞	1½ — 1⅝	1¾	1⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼ — 2½	2¼ — 2½	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	...	...	...	110 —114	110 —114	113½	113
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	101 —104	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10 — 10⅛	10⅛	$10\frac{5}{16}$
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6⅛	6 — 6⅛	6¼	...
59,254	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1¼ — 1⅜	1¼ — 1⅜	...	...
67,680	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	$4\frac{9}{16}$	$4\frac{1}{2}$
630,000*l*	City and South London Railway	Stock	$1\frac{5}{16}$%	$1\frac{5}{16}$%	$1\frac{5}{16}$%	67 — 70	67 — 70	70	69½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	...	...	2 — 2½	2 — 2½	2	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5½%	...	2½ — 2⅝	2½ — 2⅝	$2\frac{9}{16}$	2½
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5½%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4% Deb. stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
116,000	Electric Construction, Ltd., 1 to 116,000	2	5 %	6 %	...	2⅝ — 2⅞	2⅝ — 2⅞	2¾	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ..	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	...	...
111,100	Do. do. 4% Perpetual 1st Mort. Deb. Stock	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	...	...	...	¼ — ⅜	¼ — ⅜	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	10⅛%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	8 %	10 %	12 %	21½ — 22½	21½ — 22½	21¾	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	$21\frac{3}{16}$
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	2½%	3½%	10⅝ — 10¾	10⅝ — 10¾	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅝ — 16¼	15¾ — 16¼	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	15 %	15 %	35 — 38	35 — 38	37	35¼
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	133 —136	133 —136	136	134

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*** Birmingham Electric Supply Company, Ordinary £5 (fully paid) 10⅜.**

House-to-House Company, 4½% Debentures of £100, 107—109.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 15½—16½; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10 %.

London Electric Supply Corporation, £5 Ordinary, 3¼—3⅜.

*** T. Parker, Ltd., £10 (fully paid), 15½.**

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate or discount 4 per cent. (April 7th, 1898).

REVIEWS.

Alternate Currents in Practice. By FRANCIS J. MOFFETT, B.A. London: Whittaker & Co., 1898.

This work is a translation of a treatise of MM. Lopié and Bouquet, and has been undertaken by the translator with the idea of supplying English readers with a practical treatise covering the whole range of alternating currents of electricity.

It is rather a difficult matter to cover the whole range of a subject like alternating currents in a book containing only 372 pages, and we cannot expect to find in so small a space anything like complete treatment.

The book is divided into seven chapters, dealing with (I.) Alternators; (II.) Motors; (III.) Transformers and Condensers; (IV.) Transformation of Current; (V.) Distribution mains; (VI.) Current Distribution, and (VII.) Industrial Measurement of Alternating Currents.

The first three chapters, which comprise 247 pages, or about two-thirds of the whole book, are a mixture of description and theory such as is already within the reach of English readers, so that the useful addition to our literature is limited to the remaining one-third, which deals with the transformation and distribution of alternating currents. This portion should materially help electrical engineers, and form a useful reference for reasons and data concerning the various distributing systems, and it is really this part which is most suggestive of the practical engineer. It contains a good account of the methods employed in transforming from one alternating current system to another, and deals generally with the problems of transmission and distribution of electrical energy. The descriptive portions of these chapters is decidedly good, and the theoretical treatment is of a simple nature. The descriptive parts of the first three chapters are all that can be desired, the language being clear and the illustrations good, but the theoretical parts are often long and tiresome.

It seems to be a mistake to attempt to make a treatise on such a subject cover both practice and theory. There is plenty of room for two distinct treatises, one entirely practical in which difficult theoretical results may be stated but not proved, and the other devoted to establishing results whether they are known to have application to practice or not. If we were so supplied we should often be saved the tedium of hunting for practical data in book after book in the hope of finding what we want, perhaps hidden in a mass of—at the time—uninteresting figures and symbols.

The work before us is avowedly a translation, and it is, perhaps, a little out of place to review it as an entirely new production. As a translation, the book can only meet with a favourable criticism. The language is throughout precise and clear, and the diagrams and illustrations well defined and clearly explained. It would have been better if the publishers could have seen their way to produce the work at a lower cost. The price, 15s., does not compare well with other equally good publications of theirs.

An Eight Hours' Day. By W. J. SHAXBY. London: The Liberty Review Publishing Company, Limited.

This little book deals with the eight hours' question, and is generally inimical to it, and prophesies ruin if it is adopted. Our own opinion on the matter is that eight hours honestly and heartily worked, are sufficient for a day's work, and

we see no advantage in meeting foreign competition by long hours of labour. Foreign competition will not gain the day on the question of hours. It rests with the workers of the country to maintain our trade by something very different from what trades unionism has fostered of late years. We fear both the van and the rear of English trade is badly officered. Improvement must come at both ends.

The intermediates who often find the brains, and have not the authority, are usually the best men. We agree with the author in condemning legislative interference, but we are by no means entirely with him on the hours question. Any length of day is useless where the spirit to utilise it is not there. We never looked on the recent strike as turning upon the hours question. It rather turned on other considerations, which were concealed behind the so-called popular eight hours. As a fact, there is yet no real public feeling for an eight hours' day, and to force it forward is an error by whomsoever done.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

EARTH RETURNS FOR ELECTRIC TRAMWAYS. By H. F. PARSHALL, member. Paper read April 28th, 1898.

(*Concluded from page* 635.)

1. *For Conductivity* the Chicago bonds in the different tests have shown practically 100 per cent. of the conductivity of pure copper. A flexible Crown bond showed only 93 per cent. conductivity. The Columbia bonds in the cases tried showed about 90 per cent. conductivity.

2. *Resistance due to Contacts.* — Measured from the potential difference between two points very close together, one on the bond terminal, the other on the steel. Experiment showed the following results:—

Bond.	Test.	Resistance per bond (2 terminals).	Resist'nce of 176 joints, or per mile with 30-ft. rails.	Remarks.
		Ohms.	Ohms.	
Chicago Bonds ... ⅞-in. terminals in ½-in. web. 1·37 sq. in. contact area.	1	0·00000197	0·000347	Bond and hole very clean.
" " "	2	0·00000215	0·000379	" "
" " "	3	0·0000025	0·000440	Bond not cleaned; hole freshly reamed, but oily.
" " "	4	0·0000080	0·00141	Bonding not supervised.
Crown Bonds ... ⅞-in. terminals in $\frac{7}{16}$-in. web. 1·2 sq. in. contact area.	5	0·0000080 0·0000028		" "
Total ...		0·0000108	0·00190	
Crown Flexible Bond ⅞-in. terminals in $\frac{7}{16}$-in. web. 1·2 sq. in. contact area.	6	0·0000422 0·0000518		Bonding not supervised; bonds afterwards found to have been put in rusty hole.
Total ...		0·0000940	0·0165	
Columbia Bond ... In ⅞-in. hole in ½-in. web. 1·37 sq. in. contact area.	10	0·0000072	0·00127	Hole clean; bond untouched.
" " "	12	0·0000095	0·00167	" "
" " "	13	0·0000077	0·00136	Hole 4 days old; bond untouched.

Tests 4, 5, and 6 show that want of care in bonding may lead to serious increase in contact resistance.

From the tests made it may be said generally that bonds properly applied—that is, clean bonds in bright reamed holes, put in with a proper fit with a drift driven square—have practically negligible contact resistance. Experiments showed that at at least 100 amperes per square inch the drop in the contact surface was inappreciable compared with that in the bond and in the rail. The same was found true with bonds—samples of which are exhibited—that have been in use for over two years, when the current-density has been limited as stated. Experiments on this point have been carried out to a considerable extent, since it has been frequently stated that the contact resistance is a very appreciable factor, and that it can be greatly lessened by amalgamating the surfaces. This will not be the case except when there is carelessness in putting the bonds in place.

3. *Gathering.*—The current may be supposed to flow uniformly through the rail at all parts, a foot or so from the ends or from bonds. At a bond, however, it has to gather, and it is scarcely to be expected that, say, 16 inches of rail terminating at a bond should show the same resistance as 16 inches in the middle of the rail.

Tests on a bar of steel 3 inches × ½ inch showed "gathering" at the two bond terminals added resistance equivalent to a total of about 1 inch of the bars.

Tests on an 83-lb. rail showed "gathering" resistance equivalent to 3·4 inches of rail at each contact, or a total of 6·8 inches per joint.

JOINTS.

The conductance of the joints depends, as stated, on both bonds and fish-plates.

The first have been discussed already.

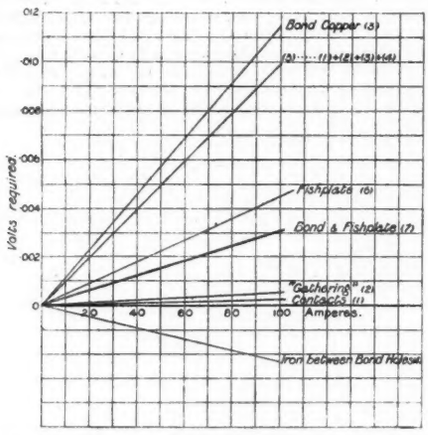
The second have a very appreciable effect, even with rails that have been in use for some time.

The following table shows the results of a number of tests made partly in the laboratory and partly on track in use:—

Laboratory tests.	Additional resistance due to joint.		
	Ohms.	Inches of rail.	Resistance of 176 joints per mile, or with 30-ft. rails.
83-lb. rail; six tests; no bonds, fish-plates uncleaned, and not fully tight.	0·0000095 to 0·000081	10 to 87	0·0017 to 0·0143
Average	0·000039	34	0·0068
Single 0000; 30-in. bond only (calculated) ...	0·000101	109	0·0178
83-lb. rail, with one 30-in. Crown 0000 bond, plates well tightened...	0·0000024	3	0·00041
Same with fish-plate removed	0·000106	114	0·0187
This bond had too great contact resistance. See Contact Test No. 5.			
TESTS ON RAILS IN USE.			
76-lb. rail; one 30-in. 0000 Chicago bond and fish-plates.	0·0000307 to 0·0000622	32 to 65	0·0054 to 0·001
Four tests made without disturbing track *average*	0·000043	45	0·0076
76-lb. rail as above (track 2½ years old); four tests	0·0000275 to 0·0000843	28 to 80	0·0048 to 0·0148
Average	0·000046	48	0·0081
Single 30-in. 0000 Chicago bond only (calculated)	0·000103	114	0·0181
Old 65-lb. rail; one 30-in. 0000 Chicago bond, fish-plates not tight ...	0·000069	57	0·0121
Above with fish-plates removed	0·000090	74	0·0158
Above with fish-plates replaced and well tightened	0·0000473	39	0·0083
New 90-lb.; two 32-in. 000 Chicago bonds and plastic to one fish-plate	0·0000081 0·0000040	10 5	0·0143 0·0071
Average	0·0000060	7½	0·0105
Fish-plate added to conductivity.			

The above values show that the contacts had not deteriorated in any way in the two and a half years of use. Some of the rails were very old, but the fish-plates, which were not fully tight, showed bright patches of metal at places of contact with rail. On replacing plate and re-bonding, the joint was equivalent to 39 inches of rail.

A second rail tested without fish-plate showed also *no* deterioration of the bonding.



Volts required by various elements of joint in 80-lb. rail bonded with 1½-inch plastic bond to one fish-plate only.

FIG. 2.

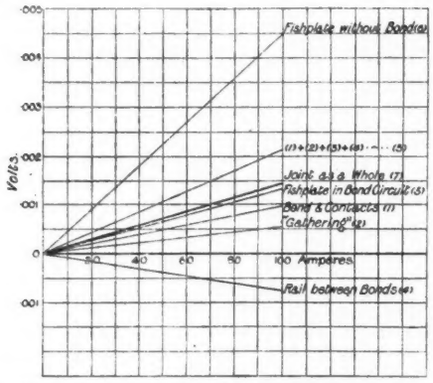
Some 66½-lb. rail laid on another line recently bonded showed joint resistances equivalent to 9½ inches to 28 inches in four different cases.

PLASTIC BONDS.

1½-inch hole in the cork receptacle between fish-plate and rail filled with plastic material.

Description.	Increased resistance due to joint.	Inches of rail.	Increased resistance of 176 joints, or per mile with 30-feet rails.
	Ohms.		
83-lb. rail bonded to one plate only; both plates separated by paper from rail	0·0000213	24	0·00375
Do., but bonded to both fish-plates; plates not very tight	0·0000126	14	0·00222
Do.; plates a little tighter ...	0·0000123	14	0·00217
Do.; plates very tight; brown paper still between plates and rails ...	0·0000117	13	0·00206
Do.; brown paper removed; plates tightened very hard up	0·0000083	9	0·00146

From the above, it seems safe to take the resistance through fish-plates as equivalent to some extra 50 inches of rail, and to take this resistance as in parallel with the copper or plastic bonds used in addition. Curves can then be constructed for any particular system of bonding similar to those of fig. 3, which gives P.D. for the various elements of a joint of 80-lb. rail bonded with a single 0000 B. & S. copper bond 30 inches long with 7/8-inch terminals.



Volts required by various elements of joint in 80-lb. rail bonded with a single 30-inch 0000 copper bond, with ⅞-inch terminal in ⅛-inch web.

FIG. 3.

The contact and gathering resistances are added to the bond copper resistance, and the resistance of the iron between the bond holes deducted. This gives Curve No. 5. The resistance so found is taken as in parallel with the fish-plates' resistance and curve (7) calculated for the whole joint. The volts so found must be multiplied by the number of joints per mile, and added to the volts required to drive the current through a mile of jointless rail.

APPARATUS EMPLOYED IN TESTING.

All resistances were found by measuring the potential difference between two points on the rails when a constant current of 30—150 amperes was passed through the latter. A standard resistance of 0·0000398 was placed in the same circuit, and the fall of the potential across this compared with that across the two points on the rail. The places at which current was led in and out of the rail were always at some distance from the points between which the potential difference was taken. Where measurements were made upon the actual track, current was supplied from an accumulator placed upon a car brought up to the spot. Current was led from this to a point in the middle of the rail to be tested, and was led out some 5 or 6 feet on the other side of a rail joint. The fall of potentiel was then measured between two points inside those by which the current was led into the rail, and also between two points on the same rail outside the places at which current was led into it. The standard resistance was included in the circuit, and comparisons taken with this at each stage. From these two measurements the resistance of the rail could be calculated as long as no cross bonds occurred upon the part of the track actually under test. To measure the resistance of the joints, a joint was included between the two points of which the potential difference was taken, and this compared with the potential difference between two points at a similar distance apart on the continuous rail. It was found extremely important in some cases to reverse the current both in the rail and the potentiometer, since with the small potential difference measured thermo-electric effects were very liable to disturb the results.

In certain experiments a current was passed into the rails at one end of the track, and taken out at the other. The current in the rails at intermediate points could be measured by taking the difference of potential between two points on the same metals which had been tested for resistance as above. This had, of course, to be done for all four lines of the double track. The volts used to drive current through the whole length of track were measured by making use of the test wires. The potentiometer was employed for this purpose also, and the results may be taken as correct, within the limits of correctness of calibration of the instrument itself, which was supplied by Elliott Brothers.

NOTES ON ELECTRIC TRAMWAYS. By Major P. CARDEW, R.E., and A. P. TROTTER, Members. Read April 28th, 1898.

The accompanying note on return feeders for electric tramways has been forwarded to me by Mr. A. P. Trotter, and as it contains a neat, graphical method for determining the fall of potential in the return with uniform distribution of current, and the proper points of application of return feeders, I think it may prove interesting in connection with Mr. Parshall's paper.

As Mr. Trotter alludes to previous suggestions of my own on this subject, I also forward a note which was prepared by me in May, 1894, and sent to the South Staffordshire Tramways Company, advocating the automatic regulation of this fall of potential.

P. CARDEW.

NOTE ON RETURN FEEDERS FOR ELECTRIC TRAMWAYS. By A. P. TROTTER, Member.

While great ingenuity has been expended in designing bonds for electric tramway rails, and while these bonds, assisted in some cases by bare copper conductors laid between or near the rails, form a considerable item in the cost of building a line, little attention has been paid to the use of return feeders. The use of return conductors, provided with a small dynamo, was suggested by Major P. Cardew several years ago, and it has been independently proposed by Mr. G. Kapp. The system has been in use for some time in Geneva, and has recently been applied with success to the extension of the Bristol tramways.

The best mode of arranging such return conductors does not appear to have been described, and the present communiction is intended to afford an opportunity for discussing it.

Assume a tramway line with passing places, five miles long, and 10 cars running. The most even distribution will, of course, be when they are equidistant, and a less even distribution is not likely to occur than when all the cars are in pairs at passing places. Let each car take 20 amperes, and let the resistance of the bonded rails be $\frac{1}{10}$ ohm per mile. When the cars are evenly distributed, half a mile apart, the rail resistance between each pair is $\frac{1}{20}$ ohm, and with 20 amperes the drop on half a mile of rails is ½ volt.

The series is as follows:—

Cars ...	1	2	3	4	5	6	7	8	9	10	works.
Volts ...	0	½	1½	3	5	7½	10½	14	18	22½	27½

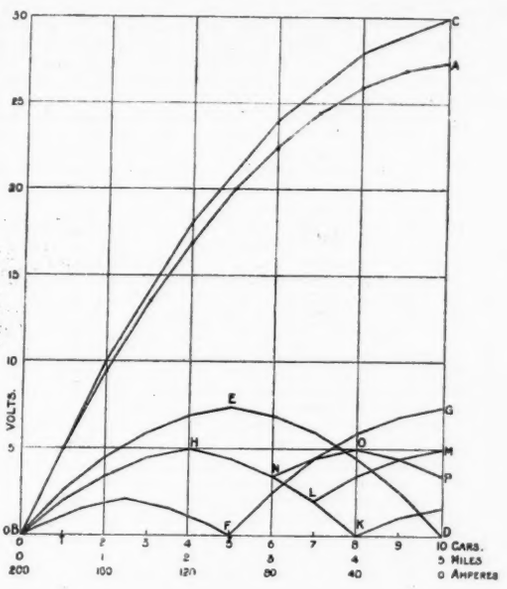
The first car is supposed to be at the extreme end of the line. The case is an extreme, but not an imaginary one. The large total fall of 27½ volts over five miles should, of course, be reduced in the first instance by more ample bonding, but the example serves the better to illustrate the problem.

When the cars are all passing in pairs, at a mile apart, the drop due to 40 amperes over one mile is 2 volts. The diagram shows the distribution for these two cases; the line, A B, showing the fall of volts for 10 cars evenly spaced half a mile apart, and the curve, C B, the full for cars in pairs a mile apart. Mathematically, the point, A, is the origin of the curve, to which the line, A B, is an approxima-

tion; but as it is not intended to treat the problem mathematically, the point, A, is, for convenience, placed at the top right-hand corner.

The volts in the two cases differ so little, compared with the fluctuations of energy on an electric tramway, that this question of distribution of the cars will not be referred to again, but the line, A B, will be considered as typical.

The return feeder method by which this fall of volts may be reduced, consists in connecting a feeder to some point on the rails, and tapping off some of the return current. The conductivity of the feeder is not relied upon for this, but a dynamo, acting as a negative



"booster," may be said to suck the current back. By this means the point at which the feeder taps the rails may be brought down to zero-potential, or might be made negative to the generating dynamo.

The problem to be considered is—(*a*) To reduce the volts below a fixed maximum; (*b*) to use as little copper as possible; and (*c*) to use as little energy as possible.

Disregarding the two latter conditions, a simple plan would be to run a feeder the whole length of the line, and to reduce the volts to zero at the far end of the line, D. The distribution is then symmetrical; half of the current goes to the generating dynamo, and half to the return feeder. To draw the curve of distribution, cut out a piece of card to the shape of the curve of volts A B, and, fitting the vertical axis to the ordinate 5, place it so that it passes through the point D. Turn the card over, and complete the curve through A in the same way. The maximum volts, at the point E, are 7½.

But there is no occasion to reduce the volts at the end of the line to zero, and there is evidently a maximum expenditure of copper and of energy in the feeder. The middle point of the line is evidently not the best point to tap, for the volts would be distributed as shown by the line B F G, which may be easily drawn by means of the template. Here the maximum is, as before, 7½, and the volts near the works are unnecessarily low, viz., 2 volts at 1¼ miles out. It is clear from the line B F G, that the feeder would draw off three-fourths of the total current. It would be still worse to tap the rails at the point at which the volts rise to one-half the maximum, viz., at about 1¼ miles from the works.

Starting now in a different manner, let it be given that the maximum volts are not, under ordinary circumstances, to exceed 5, allowing a margin of two below the Board of Trade limit. Draw the line B H by means of the template, and fitting the template so that its axis is vertical, that the top touches the line of 5 volts at the point H, and that it passes through the point B. Turn it over and draw the line H K. But as it is not necessary, from the "undertakers'" point of view, to reduce the volts to zero at the point K, set the template again, allowing 5 volts at the end of the rails at the point M, and, drawing the line backwards, it is found to intersect the line H K at L. The volts at this point are 2, and this is the best that can be done with a single return feeder. This feeder will be 3½ miles long, and will draw off 0·65 of the current.

Note on Electric Tramways. By Major P. Cardew, R.E., Member.

It is, I believe, generally admitted that where the rails are used for the collection and partial transmission of the return current, the best means of preventing injurious action on pipes is to minimise the difference produced by the current between the potential of the uninsulated return at different points, and between any part of such return and the earth. On account of the resistance offered by all conductors to the current, the transmission of a current by means of a conductor causes a fall of potential throughout the length of the conductor, the difference of potential being greatest between the ends of the conductor.

This is the case whether the whole current is transmitted throughout the length of the conductor, or is fed in (as in the case of a tramway line) at different points along the length, provided that the direction of the current throughout the length of the conductor is the same, which must be the case when this conductor forms the only path for the current back to the generating machine.

But if additional conductors are used to take current from the main conductor, which receives the current distributed along its length back to the generator, the greatest difference of potential in

Fig. 1.

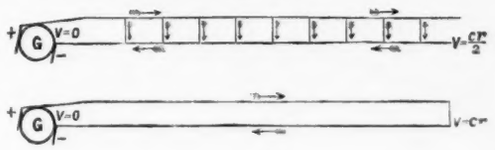


Fig. 2.

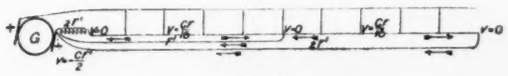


Fig. 3.

Note.—In the above figures v indicates potential with regard to earth.

this main conductor may no longer exist between the ends of the conductor, and the amount of this difference may be greatly reduced. The extent of the reduction will depend upon the position of the junctions effected and the resistance in the auxiliary conductors.

If we assume, for example, n auxiliary conductors, all of equal resistance, connected to the main conductor at equal distances throughout its length, and one from the extreme end of the main conductor of twice the resistance of the others, a resistance equal to this last being interposed between the generator and the near end of the main conductor, then with a uniform distribution of current all the points of junction will be at the same potential, and the extreme difference of potential between any points of the main conductor will be reduced to $\frac{1}{4(n+1)}$ of what it would be without these auxiliary conductors or feeders.

Thus with one feeder to the distant end alone the fall of potential in the main conductor can be reduced to one-fourth, and with a feeder to the centre as well, to $\frac{1}{18}$th, of that due to the same distributed current without feeders; and it will be seen that under such conditions the variation of potential in the main conductor can be reduced to any required limit.

But, unless these feeders are of very large cross section and conductivity compared with that of the main conductor, there will still be a considerable fall of potential in them, and in consequence a considerable difference of potential between the main conductor and the terminal of the generator to which it is connected by means of the feeders.

In place of adjusting the resistances of all feeders to equality, varying E.M.Fs. may be introduced into each feeder, proportionate to its resistance, and thus the potential of all feeding points may be kept the same as that of the terminal of the generator, if desired.

In considering the application of the feeding arrangements described above to the special case of minimising the leakage to earth from the rails of a tramway used as a return circuit, it must be borne in mind that, although the load under normal conditions may be fairly uniformly distributed, yet the exigencies of traffic may require far more current to be supplied to one section of the line than its proper share, other sections at the same time being lightly loaded.

The position and slope of the various gradients on the line also considerably affect the distribution of current in the rails. The number of cars at work, and, therefore, the total load, also generally varies during each day's running, and from day to day.

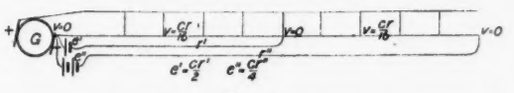


Fig. 4.

Note.—v indicates potential with regard to earth; e' and e'', auxiliary E.M.Fs

The disposition shown in fig. 4 can be adapted to meet the special requirements; but unless the auxiliary E.M.Fs. are continually adjusted to the variations of load, both as regards amount and distribution, the arrangement must be defective at times.

In order to provide auxiliary E.M.Fs. for the efficient working of the feeders to the return, automatically adjusted to the requirements, I would suggest the following arrangement:—

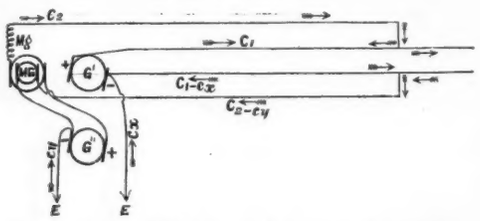
Let the tramway be divided into several sections according to its length and the amount of traffic gradients, &c.

Let there be two insulated feeders for each such section—one for the line, and one for the return; the latter being connected to an uninsulated conductor as provided in Regulation 4.

Let the current in these feeders pass through a "motor generator" at the generating station, the "field magnets" of which are excited

by the current to line alone, while the armature is wound with two circuits—one for each current, so as to oppose each other—the circuit through which the current to line passes being made slightly the more powerful. The motor generator will then revolve as urged by the line current, and will generate an auxiliary E.M.F. for the return current.

The generator for each feeding circuit should be of rather higher E.M.Fs. than that supplying the near end of the line and return; but, as the extra volts will be taken by the motor generator in the station, there will be no need to exceed the limit allowed by the Board of Trade on the line outside.



G' = generator; G'' = auxiliary generator; MG = motor generator; Mg = magnetising coils of motor generator.

Fig. 5.

The expense involved may probably prevent the adoption of any such system in its entirety at present, but it possesses the advantage that it can be adapted to existing tramways, and a pair of feeders run to any part where the difference of potential from earth of the rails is found to be excessive.

Such an arrangement with one pair of feeders is sketched in fig. 5.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

Rules made by the Board of Trade with Respect to Applications for Licenses and Provisional Orders, &c.

Consent of Local Authorities.

Rule I.—No application for a license or for the renewal of a license will be entertained unless proof of the consent to such application of every local authority having jurisdiction within the proposed area of supply is given to the Board of Trade.

Rule II.—No application for a provisional order (other than an application from the local authority of the district) will be entertained by the Board of Trade unless proof of the consent of every local authority having jurisdiction within the proposed area of supply to the grant of the order, or a request from the applicants asking the Board of Trade to dispense with the consent of such local authorities as have not consented and giving the reasons for such request, is deposited with the Board of Trade within the time limited for proving compliance with the provisions of the Electric Lighting Acts and these rules.

Rule III.—At the time of proving the consent of the local authority to an application for a license or renewal of a license or to the grant of a provisional order, the applicants must deposit with the Board of Trade copies of any agreement entered into with the local authority relating to such consent.

Rule IV.—Where the consent of any local authority is required to any application for a license or the renewal of a license or to the grant of a provisional order, such consent must be given by a resolution passed at a meeting of the local authority held after previous notice of the same and of the purpose thereof has been given in the manner in which notices of meetings of such local authority are usually given; and the fact that such a resolution was duly passed must be proved by a certificate signed by the secretary or clerk to such local authority reciting copies of the notice and of the resolution, and declaring that the notice was duly given and the resolution duly passed.

Notices.

Rule V.—Any local authority, company, or person intending to apply for a license or provisional order must at the time of lodging their memorial with the Board of Trade in the case of a license, and on or before November 1st in the case of a provisional order, give notice in writing of their intended application to every local authority, company, or person authorised to supply electricity under statutory powers within the district to which the proposed application refers.

Rule VI.—Except in the case of an application by the local authority for the district a provisional order will not be granted by the Board of Trade except to the body or person by whom the notice required by Section 4, Sub-section 1, of the Electric Lighting Act, 1882, was given.

Rule VII.—In any case where a local authority, company, or person is required by the Acts to give notice to the local authority of the district, "in such manner as the Board of Trade may direct or approve," such notice must be given in writing, and must be served, either by leaving the same at the offices of the said local authority, on or before the appointed day or by forwarding the same by post in a registered letter so that the same would in ordinary course of post be delivered on or before the appointed day.

Application and Deposits.

Rule VIII.—Every application for a license or provisional order must be made by memorial signed or sealed by, or on behalf of, the the applicants, headed with a short title descriptive of the proposed undertaking (corresponding with that at the head of the advertisement hereinafter mentioned, *see* Rule XIII.), addressed to the Board of Trade. With the memorial must be deposited six copies of the draft license or order, as applied for, with the schedule or schedules (if any) referred to therein.

Rule IX.—The deposited copies of the draft license or order must be in print. They must be printed on one side only and each schedule annexed must begin a new page.

The names and addresses of the Parliamentary agents or solicitors for the license or order must be printed on the outside of the draft.

There must be a notice at the end of the draft stating that objections are to be made by letter addressed to the Board of Trade, marked on the outside of the cover enclosing it "Electric Lighting Acts," and that such letter is to be sent to the Board of Trade in the case of a provisional order on or before January 15th next ensuing, and in the case of a license within two months from the date of the newspaper containing the first advertisement of the application, and that a copy of such objections is to be forwarded to the Parliamentary agents or solicitors for the license or order.

The draft must contain amongst other things:—

1. The address and description of the applicants.
2. A description of the proposed area of supply.
3. A statement of the purposes for which a supply is to be given, viz., any or all of the public or private purposes specified in Section 3 of the Electric Lighting Act, 1882.
4. Provisions concerning the breaking up of streets, railways, and tramways, where powers are sought to be obtained by the license or order for those purposes.
5. Conditions of supply.
6. Provisions for securing the safety of the consumer and of the public from injury by shock, fire, or otherwise.
7. Provisions for enforcing the performance by the undertakers of their duties in relation to the supply of electricity and for the revocation of the license or order where the undertakers fail to perform such duties.

The applicants must also deposit a sufficient number of printed copies of the draft license or order at offices in London and within the proposed area of supply to be specified in the advertisement hereinafter mentioned, *see* Rule XIII., such copies to be there furnished to all persons applying for them, at a price of not more than 1s. each.

Rule X.—The applicants must also deposit at the Board of Trade a published map of the district on a scale of not less than 6 inches to a mile, or if there is no published map, then the best map procurable, showing the boundaries of the proposed area of supply, and the streets in which it is proposed that electric lines should be laid down within a specified time.

They must also deposit a copy of the said map for public inspection—

In England or Ireland, in the office of the clerk of the peace for every county, riding, or division, and of the local authority of every district.

In Scotland, in the office of the principal sheriff clerk, for every county, district, or division, and of the local authority of every district

in which the proposed area of supply or any part thereof is situate.

Such deposits must be made in the case of a license when the memorial is lodged, and in the case of a provisional order on or before November 30th.

Rule XI.—There must also be deposited with the memorial:—

1. A list of the local authorities in whose districts the area of supply is situate.
2. A list of the local authorities, companies, or persons (if any) authorised to supply electricity under statutory powers within the area of supply.
3. A list of the streets not repairable by a local authority and of the railways and tramways (if any) which the applicants propose to take powers to break up.
4. A list of the canals and navigable rivers (if any) within the proposed area of supply.
5. A statement of the capital proposed to be expended and employed in connection with the undertaking, and the mode in which such capital is to be provided, or in the case of an application by a local authority a statement of the sums proposed to be expended.
6. If the applicants are a company incorporated under the provisions of the Companies' Acts, a copy of the memorandum and articles of association.
7. A fee of £50 by cheque payable to an "assistant secretary of the Board of Trade" to cover ordinary expenses. If in consequence of inquiries or otherwise additional expense is incurred, the amount will be charged to the applicants and must be paid by them in addition to the ordinary fee.

Applications under Section 13 of Electric Lighting Act, 1882.

Rule XII.—Where the undertakers under any license, order, or Special Act desire the written consent of the Board of Trade under

Section 13 of the Electric Lighting Act, 1882, to enable them to break up any street not repairable by a local authority or any railway or tramway which they are not empowered to break up under such license, order, or Special Act, application for such consent must be made by memorial, and the memorial must specially request such consent and must describe accurately the street, railway, or tramway which they propose to acquire power to break up.

PROCEDURE.

Rule XIII.—Applicants for a license or provisional order must proceed as follows, subject in the case of a license to the application having been previously entertained by the Board of Trade, *vide* Rule I.:—

They must publish notice by advertisement of their application, or in the case or a provisional order, of their intended application, and every such advertisement must contain the following particulars:—

1. The objects of the application.
2. The address and description of the applicants.
3. A description of the proposed area of supply.
4. The names of the streets in which it is proposed that electric lines should be laid down within a specified time.
5. A list of the streets not repairable by a local authority and of the railways and tramways (if any) which the applicants propose to take powers by the license or order to break up.
6. The address of an office in London, and another office within the proposed area of supply, at which printed copies of the draft license or order when applied for, and of the license or order when made, can be obtained at a price of not more 1s. each.

The advertisement must be headed with a short title, descriptive of the undertaking (corresponding with that at the head of the memorial), and it must state that every local or other public authority, company, or person desirous of bringing before the Board of Trade any objection respecting the application must do so by letter addressed to the Board of Trade, marked on the outside of the cover enclosing it "Electric Lighting Acts," in the case of a provisional order on or before January 15th next ensuing, and in the case of a license within two months from the date of the newspaper containing the first advertisement, and that a copy of such objection must also be forwarded to the Parliamentary agents or solicitors for the license or order.

The advertisement must be inserted once at least in each of two successive weeks in one and the same newspaper, published and circulating in the proposed area of supply, or in such other newspaper as the Board of Trade may direct; and once at least in the London, Edinburgh, or Dublin Gazette, accordingly as the proposed area of supply is situate in England, Scotland, or Ireland.

Rule XIV.—If any local or other public authority, company, or person desires to bring before the Board of Trade any objection respecting an application for a license or a provisional order they must do so by letter addressed to the Board of Trade, marked on the outside of the cover enclosing it "Electric Lighting Acts," in the case of a provisional order on or before January 15th next ensuing, and in the case of a license within two months from the date of the newspaper containing the first advertisement of the application. A copy of the objection must also be served upon the Parliamentary agents or solicitors for the license or order. If any local or other public authority, company, or person desires to have any clauses or other amendments inserted in the license or order, they must deliver the same to the Board of Trade, and also to the Parliamentary agents or solicitors for the license or order, on or before the time limited for bringing objections.

Rule XV.—When a license or provisional order has been granted by the Board of Trade and delivered to the applicants, they must forthwith deposit printed copies for public inspection in the offices specified in Rule X, and must supply copies to all persons applying for the same, at a price of not more than 1s. each, and must further publish the same as the Board of Trade may direct.

Rule XVI.—Where in a license or provisional order granted by the Board of a deposited map is referred to, the promoters must within one month from the grant of the license or order deposit at the Board of Trade a published map on a scale of not less than 6 inches to a mile, or if there is no published map then the best map procurable shewing the area of supply coloured to correspond with the description in the license or order. The map must be mounted on linen and must be certified as correct as regards their respective districts by the clerk or surveyor to every local authority having jurisdiction within the area of supply.

SPECIAL PROVISIONS AS TO PROVISIONAL ORDERS.

Rule XVII.—In the case of provisional orders the following additional regulations must be observed:—

1. The advertisements must be inserted in October or November.
2. A copy of the advertisement must be deposited on or before November 30th at the Board of Trade and at the offices specified in Rule X.
3. The memorial must be lodged on or before Decembr 21st.
4. The Parliamentary agents or solicitors for the order must be prepared to prove compliance with the provisions of the Acts and these rules by January 15th, and all such proofs must be completed on or before February 22nd. Six days' notice will be given of the day and hour at which such agents or solicitors are to attend for the purpose of the Board of Trade, and printed forms of proof will accompany the notice. These forms must be filled up and brought with the requisite documents to the Board of Trade at the time fixed for receiving proof.

HENRY G. CALCRAFT,
Secretary.

The Board of Trade,
August, 1890.

NOTE.—When applications for provisional orders authorising the supply of electricity within the district of any local authority are received by the Board of Trade from such local authority, and also from any other authority, company, or person, the Board of Trade will give a preference to the application of the local authority of the district in every case where, in the opinion of the Board of Trade, no special circumstances exist which render such a preference inexpedient.

In cases of applications for a license, renewal of license, or provisional order, to which objection is made by any person locally interested, the Board of Trade will, if they consider it expedient, hold a local inquiry, of which due notice will be given.

THE GAS ENGINE IN AMERICAN PRACTICE.

MR. GEORGE RICHMOND, who writes in the *Engineering Magazine*, is, perhaps, as well versed in gas engine practice as anyone in America. Up to the expiry of the Otto patent the progress of gas engines was slow in America, partly because gas was dear, and largely because gas engines were costly.

The lapse of the patent flooded the country with cheap engines, low in strength and overrated in capacity, from which a reaction has now set in, and substantial, well-drawn engines appear reasonably certain to be soon sold in large numbers. And it is in producing electricity that Mr. Richmond foresees a brilliant future, especially with its congener, the oil engine, for the electric lighting of country houses and villages, for the average conception of America as a country of huge and hideous cities is by no means the whole truth. We have in mind as we write a little community—half village, half a mere locality—which is by no means far removed in character from that peaceful quiet which characterises some of the off-track villages of our own Sussex.

While our author refers to the Diesel motor as a brilliant success as compared with the Brayton engine, which it resembles in its operation except for its intended isothermal combustion, he states its cycle to be theoretically inferior to that of Brayton, though rendered a success by the fact of compressing to ignition temperature. Evidently Mr. Richmond is not to be caught with chaff, and has a very poor opinion of the "ripening and cooling spark" twaddle on which the Kane Pennington motor was sold to British investors. He seems honestly ashamed of this motor being of American origin, and therefore publishes cuts of really sound American engines.

On the other hand the Gardie engine, taken over to America about the same time from Europe, was really sound, but was wrecked by stock jobbing. It was Americanised as the Bates triple thermic motor, and in its operation both gas and air were separately compressed and heated thereby to about 390° F., and being then passed through regenerators to 750° F., the gas and air being still separate. They are then discharged to the motor cylinder in thin jets or layers alternated—we are not told if this stratification was really secured. On ignition by contact with an igniter (? a tube), the temperature rises to 2,730° F., the products of combustion expand, and the spent gases, still hot, pass out *viâ* the regenerators. However, good or bad, a $5,000,000 company was too much for this motor, and forthwith close on its heels, comes the Diesel motor, with an advance syndicate of a modest million dollars only. This motor he looks on as a triumph of mechanical work, with its 35 atmospheres compression and its 75 per cent. efficiency.

In the Otto engine, pressures of compression up to 38, 66 6 and 87·5 lbs. above the atmosphere gave 17, 21 and 25 per cent. efficiency, and 95 lbs. was recorded by Mr. Clark to have given 30 per cent. efficiency. The Diesel has shown 34 per cent. at 450 lbs. compression, a result disappointing, and only satisfactory as a mechanical performance; the net efficiency, after paying for the various complications, being poor for such a high pressure.

In the case of the Otto engine with 95 lbs. compression above quoted, the initial pressure was 310 lbs., so that, as regards mechanical difficulties, the Diesel may be assumed the more difficult with its 450 lbs. The Diesel engine only modifies Beau de Roche's cycle in the ignition period; it does not closely follow the Carnot cycle, at which it aims.

Our author considers that the belief in the advantage of the isothermal combustion arises from a misconception of the doctrine of Carnot, or rather a misapplication of it, and he does not think the isothermal expansion of the Diesel cycle is even its most valuable feature, while the difficulty in securing it will be very great.

The German type of gas engine was the first to be taken up in America, but the British type now seems to be gaining ground. In the gas engine, if anywhere, our national characteristic of solidity and weight ought to tell favourably. While various ingenious arrangements for direct connection have been tried, Mr. Richmond considers the link belt, run slack with a fly-wheel on the dynamo, as there ought always to be, will hold its own until a more simple system of direct connection is found.

The enormous amount of money spent in getting up new gas engines is attributed to the fact that the new designer starts out with a great contempt for all previous work. About £2,000 is spent in teaching the new man elementary ideas, a second £2,000 in trying revolutionary modifications, and the third in getting the engine to run as economically as others in the market. Our own personal observation tells us that many light-built engines run exceedingly

well—when new—but we can recall no old-established gas engine that is not very heavy to-day about the cylinder. Mr. Richmond appears surprised at scientific Germany being not exempt from the above cycle of £2,000 ideas. He instances the first Diesel engine as being built without the water jacket, as compounding being now in course of being experimented upon at great expense, while to these ancient and exploded fallacies is being added the isothermal combustion "elaborated with a quasi-scientific and solemn minuteness intended to be admired rather than understood." But perhaps Mr. Richmond does not know his Shakespeare. If he does, when he gets a full-blown Diesel, minus jacket and with the many atmospheres of compression, he may think it "like a German clock still a preparing; ever out of frame; and never going aright, being a watch. But being watch'd that it may still go right."

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.**, *Electrical Patent Agents,* **322,** *High Holborn, London, W.C., to whom all inquiries should be addressed.*

9,466. "The compact electric switch." P. H. Brant. Dated April 25th.

9,475. "Improvements in and connected with arc lamps." F. R. Boardman. Dated April 25th.

9,482. "Improvements in apparatus for freeing, lighting, and extinguishing gas burners at a distance by means of electricity." P. L. Guyenot. Dated April 25th.

9,493. "Improvements in or relating to 'starting boxes' or combined rheostats and automatic cut-outs for electric motors." A. J. Boult. (F. E. Herdman, United States.) Dated April 25th.

9,504. "Improvements in operating mechanism for the switches of electric railways." J. W. Mackenzie. (C. W. Squires, United States.) Dated April 25th.

9,511. "Improvements in rheostats for the graduated control of electrical resistance, particularly applicable to the production of theatrical luminous effects." C. E. Clemancon. Dated April 25th.

9,534. "Improvements in incandescent electrical devices." W. L. Wise. (C. Hubert, United States.) Dated April 26th.

9,548. "Improvements in electric arc lamps respecting arc striking arrangement." P. Spies. Dated April 26th. (*Complete.*)

9,581. "Improvements in coin-freed or prepayment apparatus for supplying electricity." A. G. Ionides. Dated April 26th.

9,607. "Improved electric arc lamp." J. T. Tschiebret. Dated April 26th.

9,637. "Improvements in process for the production of chemical compounds by electrolysis." J. W. Richards and C. W. Roepper. Dated April 26th. (*Complete.*)

9,638. "Process for manufacturing metallic sulphides electrolytically." J. W. Richards and C. W. Roepper. Dated April 26th. (*Complete.*)

9,677. "Improvements in swing joints or ceiling connections for carrying suspended electric light fittings." Veritys, Ltd., and P. G. Ebbutt. Dated April 27th.

9,692. "Improvements in resistance apparatus for regulating electromotors." Siemens Bros. & Co., Ltd. (Siemens & Halske, Aktien-Gesellschaft, Germany.) Dated April 27th. (*Complete*)

9,712. "Improvements relating to telephones and to circuit arrangements and relays therefor." O. J. Lodge. Dated April 27th.

9,714. "Improvements in portable electric batteries and electric lamps." G. F. Emery. Dated April 27th.

9,723. "Improvements in electric current switch gear." L. Andrews. Dated April 27th.

9,739. "Improved means and apparatus for electrolytically decomposing salts of the alkaline and earthy metals or other substances containing them for the manufacture of caustic bleaching powder chlorine, or other products contained in them." F. H. Bowman and F. E. Bowman. Dated April 28th.

9,778. "Improvements in plates for electric accumulators." M. Bernstein. Dated April 28th. (*Complete.*)

9,779. "Relating to improvements in testing and projecting apparatus used in conjunction with telephone, telegraph, or other electrical circuits." D. Sinclair and W. Aitken. Dated April 28th. (*Complete.*)

9,789. "Improvements in, and connected with, electroliers and incandescence electric lamp pendants." H. Hirst and J. H. Collings. Dated April 28th.

9,802. "An improved system and means for driving newspaper printing, or like machines, at variable speeds by electric motors." W. A. Clatworthy, W. H. Holmes, A. Holmes, J. H. Holmes, L. W. Holmes, and E. Holmes. Dated April 28th.

9,811. "Improvements in, and relating to, dynamometrical apparatus." H. Bourbon. Dated April 28th. (*Complete.*)

9,844. "Improvements in adjustable shade supports for electric and the like fittings." W. H. Sturge. Dated April 29th.

9,877. "Improvements in electric switches." J. G. Dixon. Dated April 29th.

9,881. "Improvements in means and devices for electrically lighting coin-freed apparatus for displaying pictures." A. W. Witt and M. W. Stikeman. Dated April 29th. (*Complete.*)

9,912. "A new and improved chimney for incandescent gas, electric, and oil lights." M. Altman. Dated April 30th.

9,921. "An electric brake." F. Wise. Dated April 30th.

9,960. "Improvements in or relating to electric meters." A. J. Boult. (E. L. G. Cauro, Italy.) Dated April 30th. (*Complete.*)

9,983. "Improvements in or relating to telephonic apparatus." R. Gunther, E. von Kronmysth, jun. Dated April 30th.

ELECTRICAL PATENTS OF 1884, EXPIRING IN MAY, 1898.

We are informed by Messrs. W. P. Thompson & Co. that about 96 applications for electrical patents were filed in the month of May, 1884. Out of these only three have been allowed to run their full length of term, viz., 14 years, and being of considerable interest we give short abstracts of them below:—

7,668. "Electric meter." J. S. Raworth. Dated May 13th, 1884. Relates to current meters. In one form of the instrument, for use as an electro-dynamometer, a pivoted iron spindle provided with two iron arms projecting from its ends in opposite directions, is surrounded by a low resistance coil, portions of which are parallel to the arms. When a current passes through the coil the spindle becomes magnetised together with its prolongations, which are then deflected by the portions of the coil which are parallel to them in opposition to a volute spring, one end of which is connected by an arm to an index and the other end to a spindle. The deflecting force is measured by the angle through which the spindle must be turned in order to bring back the index to its original position. In a modification for use as a voltmeter, the low resistance coil and its prolongations are replaced by coils of high resistance. 1 claim.

7,773. "Improvements in electric signal apparatus for fire alarms, telephone calls, and for like uses." H. A. Saundess and A. C. Brown, Dated May 15th, 1884. Relates to that kind of electric signalling apparatus in which the pendulum of a transmitting instrument sets in motion the isochronous pendulum of a receiving instrument in the same circuit, and consists of improvements in the transmitting and receiving instruments. The transmitter consists of a conducting rod suspended by a flat spring and carrying a flat spring, to which is attached a pendulum with an adjustable bob. The conducting rod swings between adjustable contact stops and breaks the circuit once in each vibration of the pendulum. Another form of transmitter has an ordinary adjustable pendulum, to which is attached a spring contact arm, bearing on contact pieces so arranged that the circuit is made and broken several times in each swing. The receiver has a pendulum suspended by a spring or pivot, and with the lower part of the pendulum connected with the upper by a flat spring. An electro-magnet excited by currents from the transmitter acts on the upper part, and sets the pendulum in motion. The motion of the upper part of the pendulum is limited by the electro-magnet and the stop. Methods of using these instruments for fire alarms, telegraph, telephone, messenger and police calls, and railway trains, are described in the specification. 5 claims.

8,448. "An electric switch." E. F. H. H. Lauckert. Dated May 30th, 1884. Relates to electric switches and consists in adapting carbon rods so that the sparks which may occur on making and breaking contact may pass between the carbon rods instead of the metallic surfaces. The carbons are fixed to the other parts by springs, and are so arranged as to be the first to make and the last to break. 1 claim.